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SOME ASPECTS OF GRASS-FARMING ADVANCEMENT IN NEW ZEALAND.

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[Following a conference held in 1930 relative to grassland questions, Mr. W. V. Blewett, of Imperial Chemical Industries, Ltd., personally donated the sum of £20 as a prize for an essay competition on the subject of grass-farming advancement in New Zealand, with special reference to field and research work and possible methods of co-operation among our grassland workers. The essay was limited to 10,000 words in length. Judging of competing essays was delegated to a committee consisting of Dr. H. H. Allan (Plant Research Station), Professor G. S. Peren (Massey Agricultural College), and Mr. L. J. Wild (Feilding Agricultural High School). The competitors, twenty-three in number, included many prominent workers from our main organizations engaged in research or instruction in this branch of knowledge. The committee unanimously awarded the prize to Mr. Connell's paper here published.]

RELATIVE HIGH PRODUCTION OF NEW ZEALAND GRASS-FARMING.

THERE are several outstanding facts that must be considered in any useful study of New Zealand grassland work. One of the foremost of these facts is that while there are many deficiencies in the present average standard of New Zealand grass-farming, yet the better-class New Zealand farmers are in the van, when lined up with the better-class farmers of all countries, as regards their results in the profitable growing of grass and the converting of that grass into cash. This fact has been attested to by overseas visiting authorities competent to express reliable and disinterested opinions. During recent years we have had the published impressions of such visitors as Professor Stapledon, Sir John Russell, the leaders of the party of British farmers, Dr. Wing of Cornell, and Dr. Russell of Wisconsin, all of whom expressed mingled surprise and admiration at the standard of our grass-farming.

But, apart from such authoritative spontaneous testimony, we have the evidence provided by comparison between production from grass in New Zealand and that in other countries. A production of 200 lb. to 300 lb. of butterfat from an acre is not at all rare in New Zealand; in other countries it is phenomenal, if it has been recorded at all. Likewise, the New Zealand sheep-farms which have been made capable

of providing sustenance sufficient to meet well the requirements of six or seven ewes to the acre seem to have few or no counterparts in other countries. The fact that our better-class farmers are not equalled, as a rule, by farmers of other countries, in point of production from grass, drives home the futility of seeking much inspiration or guidance from the grass-farming of other countries.

Considerations regarding Value of Overseas Experience.

On the part of some there has been a tendency to attribute to imported teachings a value which there was no assurance they possessed. Two recent instances rather well illustrate the possibility, unless proper care is taken, of attaching artificial values to overseas happenings.

The first is the Tollesby Farm experience of Mr. Brunton, which has been featured in advice given to farmers. With dairy cows, under his system Mr. Brunton secured annually 317 grazing-days an acre. In comparable New Zealand trials, with much less special effort, in some dozen of instances well over 400 grazing-days an acre have been secured—a fact which assists in viewing Mr. Brunton's performance in its true standing. The second is the Hohenheim experience, which has often been advanced as impressive evidence of the outstanding value of a particular system of grazing management. The fact that under the Hohenheim system the production obtained was equivalent to approximately 160 lb. to 180 lb. of butterfat an acre annually would tend probably to give New Zealand farmers who were not previously aware of it a new perspective relative to the Hohenheim results, particularly if they knew the acre production of good New Zealand farms. From the foregoing facts it does not follow that such experiences as those of Tollesby and Hohenheim are of no value to New Zealand: they are always likely to be instructive and therefore valuable. The danger lies in overvaluing them.

It may be contended that it is to our external circumstances rather than to our personal efficiency that we owe our outstanding position as producers from grass, but even if this is so it does not affect the conclusion to be drawn from the data just considered. The conclusion is that in view of the high production obtained by our leading farmers the most promising source of leadership in grassland practice is within ourselves. The fact that others have poorer production because of external circumstances is away from the point, because circumstances enter into the essence of the matter. The outstanding position of New Zealand grass-farmers should give a sense of pride, but also of responsibility in that it shows we cannot lean on others but must evolve our own means of progress. It would be difficult to overimpress this on some who endeavour to give guidance on grass-farming through the columns of the press. Once the true position is properly grasped there should be less inclination to offer as guidance what often is of less than no value as guidance—real or supposed overseas developments. To avoid any chance of misconception it may be as well to state that while we should be self-reliant we should not be self-centred—we should not neglect to study developments overseas. The recent work of Linehan and Mercer in regard to rye-grass well exemplifies the need of keeping in touch with work of other countries.

Present Knowledge not fully applied.

Another outstanding fact relative to our grassland work is a regrettable failure to apply fully the knowledge that is available. This failure is demonstrated by the fact that we find repeatedly certain farmers whose returns are 40 per cent. or more better than those of many of their neighbours operating under similar conditions of soil and climate. The following instances typical of the position are recent developments :—

In three years Farmer A increased his butterfat-production from 15,000 lb. to 30,000 lb. butterfat annually on a farm typical of an area of 80,000 acres. This was done by the introduction of methods accepted as standard by those acquainted with recent developments. The striking increase in production is only one of the significant aspects of this performance. The other is that the production of much of this 80,000 acres is still at the point where the production of the particular farm was prior to the introduction of approved modern practice.

As if it were to demonstrate that the performance of farmer A was in no way freakish, Farmer B, operating in similar country, has raised his production in six years from 7,900 lb. to 21,000 lb. of butterfat. Again this was done simply by the introduction of approved modern practice.

On totally different country Farmer C in five years raised the carrying-capacity of a farm of 1,000 acres from 1,400 ewes to 3,000 ewes. This was done by the adoption of ordinary up-to-date practice. Again, generally, the neighbouring farmers are in a similar position to that of C four or five years ago.

That instances similar to the specific cases cited could be multiplied, and that such cases are indicative of the position generally, is rather strikingly confirmed by official data recently made available as a result of studying 1,600 dairy farms extending over 200,000 acres. It was found that while the returns of 10 per cent. of these farms were good, the results of 67 per cent. were of an intermediate or indifferent type, and the returns of 23 per cent. were poor or disappointing. The superiority of the 10 per cent. of farms obtaining good results must be due essentially to the application of knowledge now available. If the position were remedied so that farms obtaining the intermediate and poor types of returns obtained good returns, then our dairy production would approximately double. At first sight this may seem an over-optimistic estimate, until it is considered in the light of the fact that during a recent decade our dairy production was doubled and that this was obviously done without minimizing our sheep industry, since the sheep population increased by several millions during the same decade.

As those obtaining the highest results were most likely not fully exploiting our present knowledge, it is indeed difficult to gauge accurately the full potentiality for increased production in complete exploitation of our present knowledge. The potential improvement from thorough application of our present knowledge appears to require some emphasizing, for the impression seems now to be in the minds of some that the only avenue to any substantial improvement in production is research.

There will be later reference to the need for research, but in the present connection it seems worth stressing that while, on the one hand, the results from efficient work concentrated on research are to some extent of problematical value as means to increased production, in that research may tell us simply that many of the practices approved of to-day are really the best, on the other hand, the results from fully efficient and general application of our present knowledge mean a very substantial advancement of our grass-farming.

Facts underlying Poor Application of Knowledge.

It may well be asked, Why do many farmers fail so lamentably in making use of our available knowledge? Contact with farmers has shown that the main causes of this are as follows, no attempt being made to name them in the order of their influence: (1) Financial considerations—farmers know what to do to achieve better results, but are deterred from doing it by financial considerations; (2) indifference, mainly operative when a comfortable living follows present inefficient methods; (3) lack of knowledge of the information available; (4) knowledge that information is available coupled with hesitation to accept such information as reliable guidance to better farming.

Nature of Sources of Knowledge regarding Pastures.

The fourth of these causes is worthy of consideration in an examination of our grassland work. Why is there hesitation to accept some of the information offered, it may well be asked. Instructional work is at times linked with field experimentation involving the use of plots. There seems to be a widespread feeling among farmers that at times they cannot place a great deal of reliance on the evidence provided by such plots. Farmers who readily admit the need for investigation and who allow that the specialist worker may find plots of value in his work yet act on the belief that such plots by themselves do not provide reliable guidance to better farming. In this connection the farmer may not be illustrating his unreasoning conservatism, as some would hold, but his good judgment, which possibly has enabled him to recognize, more readily than those who would teach him, the shortcomings of the plot system. Of prime importance among these shortcomings is the questionable validity of the means of measuring plot results—a matter which will be discussed later.

The tendency to question the reliability of recommendations based on field plot work applies, but more intensely, to recommendations based on laboratory determinations.

Such considerations bring up the question of basing advice on evidence other than that derived from field plot or laboratory investigation, and make it opportune to recall that there is a wealth of practical knowledge to be gained from a thorough study of general farm experience and that such knowledge would as a rule readily gain the confidence of the farmer. Two instances, both of which have been obtained from official sources, may be cited.

In the first instance, examination of the farms of a district showed that they could be divided into two groups which were similar in respect to soil, size, top-dressing, and average yield of herds, but that in one group the pastures were not allowed to become long and mature in the

summer, while in the other group the pastures became long. In the former group the average butterfat-production an acre was 30 per cent. higher than in the latter. One can imagine farmers readily accepting the conclusion to be drawn. In the second instance a study of 210 herds showed that, with those that averaged from 300 lb. to 350 lb. butterfat a cow, over 7 cwt. of phosphatic top-dressing per cow was used, whereas with those herds averaging under 220 lb. per cow the amount of phosphate used was less than 4 cwt. a cow. From such facts we have a finding that the farmer would not be inclined to question.

The matters just considered lead naturally to another fact of considerable importance. This is that the bulk of the knowledge on which our present relatively efficient practice is based has come not from the laboratory or from trial plots, but from the field work of the practical farmer. To exemplify this we need only recall the origin of our knowledge of such matters as top-dressing, ensilage, and the high nutritive value of leafy grass. At times the field plot and the laboratory have facilitated progress in a valuable way, but at times, again, if the practical farmer had followed the field plot or the laboratory findings, he would have gone astray. There is, for instance, a district in which in field plot trials no evidence of benefit from the application of phosphatic top-dressing can be found, even when plots which have received 9 cwt. an acre of phosphate in three years are compared with adjacent control plots. Yet when the cash returns of farms of the district which have been top-dressed are compared with the returns of similar ones which have not been top-dressed, there is indisputable evidence of profitable responses to the top-dressing. In such a case trial-plot evidence was obviously misleading.

Enough information has been given to make it clear that we should not neglect the opportunity of learning from farmers themselves by suitably collating the experiences of many farmers. We should remember that farmers as a class are extremely practical research workers, and that the value of knowledge obtained from them has been demonstrated.

The Need for Research.

A further important fact of the grassland position is that there is great need for extensive research. Despite any view or fact in the foregoing statement that may seem to imply a contrary conclusion, research is essential to the fullest measure of success. To indicate the important bearing of research one need only describe briefly some of the problems that are calling for solution.

The subject of top-dressing alone provides many problems of economic importance. There is, for instance, little or no definite knowledge regarding the returns from much of the lime, potash, and nitrogen applied to New Zealand grassland. Possibly the amount of money spent on these fertilizers should be greatly increased: possibly it is being largely wasted. There is likewise much indefiniteness about the best use of phosphatic fertilizers. In brief, there are dozens of important points regarding top-dressing about which we can express only opinion, whereas knowledge is most desirable.

Those who to-day are best informed in regard to pasture establishment also most completely realize how imperfect our knowledge about

it is and what promising fields it offers for successful research. The relatively recent developments in regard to strains of rye-grass are but a foretaste of what might follow from thorough exploitation of differences between strains of other pasture species, while the most advantageous use of the different pasture species is a matter about which our knowledge is still decidedly vague.

In the vital matter of pasture utilization there is yet much unexplored ground. The practice of rotational grazing, about which some are prepared to proffer such specific instruction, rather well illustrates the position. If a request were made for the evidence on which such specific instruction is grounded, then generally those responsible would have some vain searching.

While some are prepared to be dogmatic in regard to the details of pasture cultivation by harrowing, &c., many of those who have given the matter close and extended study would welcome considerable further research. This brief outline must suffice to illustrate the scope for research into methods of grass-production.

Importance of Management Problems.

In drafting any programme of grassland research it is of extreme importance to remember that the grass-farmer is faced not only with problems relative to the technique of grass-production, but also with problems relative to the management of grass-farms. In the former problems the pastures are the units of study; in the latter the farms as a whole are the units. In the former problems the essence of the matter is the efficient growing of grass; in the latter it is the making of profit. From this it would seem to follow that the efficient growing of grass is not necessarily sufficient by itself; and this is actually so, for the benefits that might be expected from efficient growing of grass are nullified if the resultant feed is not used advantageously. In short, farm-management as distinct from grassland-management governs success. It is of particular moment that attention be given to problems of grass-farm management, for in the past, rightly or wrongly, these problems have not received much systematic study. Possibly in the past the technique of good grass-production was so poorly understood that it warranted the greater share of attention, but now, seeing that our knowledge of technique has been so improved, the need for attention to problems of farm-management has become much more acute.

As a rule, unfortunately, farm-management problems are of greater complexity and of greater ramification than farm-technique problems, and possibly this explains why we have been somewhat slow in attacking them. Probably the nature of these grass-farm-management problems will be indicated most readily by citing the following specific ones which have recently presented themselves:—

(1) When increased grass-production on a one-man dairy farm wholly in grass may make it necessary to employ another man for milking, although there is not enough work for two full-time workers, what should be done?

(2) When the whole of the pastures of a farm are in good order, what circumstances determine the advisability of breaking up some of the good pastures in order to grow supplementary crops?

(3) What classes of farms are exceptions to the rule that every grazing farm should practise ensilage annually?

(4) Under what circumstances is it profitable to introduce sheep to dairy farms?

(5) In North Island farming, what circumstances justify a change-over to the use of Southdown rams?

These few instances of farm-management problems will suffice to show, firstly, that they have originated in modern grass-farming developments, and, secondly, that it is impossible to solve them by means of any formal field experimental work.

Basic Problem lies in Technique of Investigation.

This brings us face to face with a fact that applies not only to this class of problem, but to many of the other problems already mentioned. This fact may be stated by saying that the biggest problem of grassland research to-day is the discovery of efficient methods of investigation. At first sight, to the layman at least, the greatest difficulty in the sphere of research is the securing of funds, equipment, and staff for the carrying-out of the work. It is assumed that, given the men and the money, it would be an easy and simple matter to find out the answers to the problems which confront us. Actually, if there were an ample supply of men and money, there would be no assurance of immediate sound progress towards a solution of many of our problems that seem so straightforward.

The difficulty wholly arises from the extremely doubtful validity of commonly utilized means of measuring differences in field experimental results. Let us consider this matter more particularly, for it is one of prime importance. Assessing of differences among trial plots by mere observation is generally recognized as a crude method at best—which may be of some service, but only until one wishes to express differences in terms of financial returns. The adoption of a system of mowing and weighing of herbage from plots might seem to eliminate to a large extent the weakness of observational means of ascertaining differences in results, and this is particularly so when we find this method linked up with an authoritatively designed and elaborate system of eliminating the disturbing influence of soil and other variations likely to occur in a series of plots. But the value of the whole system of mowing, weighing, and calculating is immensely discounted in practice by the fact that the system ignores the factor of quality in herbage, which is already known to be of basic importance; and, as if this were not enough, it has been found that mowing, if continuously persisted in, speedily gives a sward substantially different from what would have resulted from a similar period of grazing. Hence an investigator utilizing the mowing method for the determining of differences in trials regarding grazing problems would soon find himself determining differences of no particular value, because they would have no counterpart in practice. A system of alternate grazing and mowing would minimize this weakness, but it would not surmount the difficulty of assessing herbage quality. It has been thought that to supplement the results obtained from this latter method by data obtained through chemical analysis of the herbage would enable grassland experimental results to be measured efficiently. But it has been

found that available methods of chemical examination do not satisfactorily indicate such matters as palatability and digestibility of the herbage; and these factors would seem to be far too important to be overlooked in any investigational work which aims to supply reasonably accurate guidance.

From this brief account it becomes clear that there is doubt whether, in respect to experimental methods, research workers to-day are very far in advance of research workers of thirty to sixty years ago when the animal was used for measuring the results of trials designed to indicate the comparative nutritive value or quality of feeding material. There is some encouragement in the fact that the investigations of that period yielded some most valuable information. During that period, for instance, took place the epoch-making work of Fjord which gave us the Scandinavian feed-unit system that incidentally played no small part in enabling Denmark to take the place she occupies to-day as a producer of butter and bacon. "I am doing no more than making systematic records of the experience of practical farmers" was a frequent expression of Fjord's when speaking of this important work, and that expression surely is of significance to-day. During the same period also was commenced Somerville's classical work at Cockle Park, and allied trials which had such a pioneering influence in fostering phosphatic top-dressing. Somerville, it is interesting to find, insisted in his report that the animal is the only effective measure of the results from top-dressing and other grassland practices.

It is well to examine carefully whether we have made any progress in the technique of pasture trials since Somerville's pronouncement.

Problems illustrating Difficulties relative to Technique.

Apart from any question of its accuracy, the method of employing stock to measure results in grassland investigations is costly and cumbersome, and it is on this account principally that alternative methods of measuring experimental results are sought. The question may fittingly be raised whether we do not tend to go too far at times in our search for simple experimental methods—whether we do not attempt the impossible task of making simple that which is inherently complicated. Two current problems seem to illustrate this rather well. In the first place, we have the matter of North Island hill-country top-dressing. Is it reasonable to expect ever to be able to obtain worthwhile information on this matter by any investigations except those in which farms, not plots or fields, form the unit of comparison? The futility of comparisons between plots or fields is suggested by the fact that top-dressing may influence not only stock-carrying capacity, but also stock mortality, quality of stock, date of buying and of selling of stock, which in turn might affect prices, quantity of wool, quality of wool, and possibly other matters besides—a potential complexity of influences that baffles simplification.

In the second place, we have the matter of nitrogenous top-dressing of dairy farms. Such top-dressing, through providing extra growth at critical times, may lead to an all-the-year increase in the number of cows milked. Indirectly this may lead to the more economical utilization of feed which, failing the use of nitrogen, would be poorly utilized or wasted. Further, it may lead to the elimination of the necessity

for costly special crops. From all this it seems clear that the returns from nitrogen top-dressing are not to be measured by finding out the number of extra pounds of butterfat produced on the fields to which the nitrogen was applied, or by merely finding out the increase in the amount of grazing on those fields and calculating this extra grazing in terms of butterfat or its cash equivalent. The crux of the position lies in the fact that the nitrogen top-dressing may influence the returns from fields to which it was not applied, because the use of nitrogen on certain fields may enable the grass growth on other fields to be more effectively utilized.

The problems of North Island hill-country top-dressing and of nitrogenous top-dressing of dairy farms are typical of a class which will probably grow in number as our grass-farming becomes still more improved, and which does not seem to give promise of solution by any simple measures. That improved grass-farming would beget such problems is confirmed to some extent by certain problems which already seem to be looming. One of these is the possibility of winter butterfat-production as a fairly general thing. Men who hold responsible and authoritative positions in the marketing world have pointedly advocated all-the-year-round dairy production as a dependable means to better returns from our dairy-produce.

There are two recent developments which bear on the position:—

(1) Data submitted by the Farm Economist, Department of Agriculture, support the view that all-the-year-round production may be expected to be favourably reflected in our marketing. The data show that (*a*) New Zealand butter approaches Danish in price not when there is a scarcity of total butter or of Danish butter on the British market, but when there is a scarcity of New Zealand butter; (*b*) that the New Zealand price slumps below Danish not when there is a glut of total or of Danish butter, but when there are abnormally heavy deliveries of New Zealand butter. In fact, the official figures suggest that, to an appreciable extent, the biggest competitor of New Zealand butter is other New Zealand butter, and that the competition between New Zealand lines of butter is the main cause of big differences between prices of New Zealand and Danish butter. This is what even a slight knowledge of marketing would lead one to expect, seeing that New Zealand, according to official figures, has been delivering over 53 per cent. of her total output on to the British market within four consecutive months.

(2) Recent modifications in our grassland practice relative to top-dressing, ensilage, &c., seem to have made winter butterfat-production not such a remote possibility as it was held to be prior to the introduction of these modifications. Further, prospective increases in our output of dairy-produce promise to increase the urgency of spreading our output more evenly on the market. The problem is whether it will be an economic proposition to spread dairy-produce deliveries by means of winter production. It is a particularly instructive problem in its bearing on the main subject herein considered. It is just as much a grass-farming problem as it is a marketing problem. It illustrates very well that any programme of grassland work should embrace not merely the technique of production, but also the management or business side of grass-farming. It illustrates also the class of problem calling

for investigation by methods other than those which employ the field plot or the laboratory, and finally it introduces the difficulties attaching to the technique of investigation.

In relation to the space available the problem of experimental technique has herein been given considerable attention because it is one of the greatest affecting the advancement of grass-farming. It certainly is of basic importance, since, until sound methods of carrying out investigation have been evolved, the value of any investigational work may eventually be greatly discounted because of the discovery that the methods used in seeking the solutions were not fitted to supply the information sought. Indeed, the adoption of unsound experimental technique may be productive not merely of results of little value, but of results which are actually harmful, in that they may misinform and thereby lead to the adoption of uneconomic practices.

Major Matters regarding Research summarized.

To sum up on the matter of grassland research, while there is much scope for valuable work in the main aspects of grass-farming, there are two matters to which attention specially requires to be directed, because, firstly, of their intrinsic importance, and because, secondly, of the fact that there is a tendency to unduly ignore them. One of these matters is research into the business of grass-farming as distinct from research into the technique of grass-production. The other is research into the technique of research. In other words, let us ask ourselves how we may efficiently ask the questions to which we desire answers; what tools and what materials we may use in efficiently solving our problems. It is somewhat regrettable that to the average layman this great fundamental problem of experimental technique scarcely exists, and so any suggestion of expenditure on the problem will be apt to be viewed with a mixture of disfavour and curiosity by the general public. Actually, to proceed with certain types of important research until this problem is solved is to take the risk of building on very unsound foundations.

Fundamental Facts relative to Organization of Grassland Work.

A most important further fact is that grassland advancement constitutes a unit task which can for convenience of examination be divided into the following activities: (1) Determination of the real problems of grass-farming and of the relative urgency and importance of these problems; (2) discovery of truths which solve the problems; (3) dissemination of these truths so that our knowledge may be applied.

That these three activities are but parts of a single task is readily discovered by considering either the probable effect of eliminating any one of the three from a scheme of grassland advancement, or the probable effect of isolating one and concentrating attention on it to the neglect of the others. In either case inefficiency would soon become apparent. What is required is a well-balanced combination of the three activities. To obtain this, team work is essential, as it is for any other similar human enterprise.

Further, it has become practically axiomatic that there can be no surety of efficient team work except on the basis of unity in planning and direction. The fundamental weakness of New Zealand's grass-farming

work is lack of unity in planning and in direction. What body, it may well be asked, has the authority, combined with the knowledge, to preserve a proper balance between research and advisory work? What body has the power to prevent one branch of research being fostered unduly at the expense of other equally worthy branches? What body has the power to ensure that money is not spent on matters which are of relatively little consequence while may be other matters of prime importance are being neglected? What body has the power to prevent unnecessary and therefore wasteful duplication of effort and equipment? No body has such power, and therein is the weakness.

Were all the work of grassland advancement placed in the hands of one body the weakness would disappear. In considering practicable ways of eliminating or minimizing the weakness we may begin with the fact that the work of enunciating our grassland problems and of fostering the application of our grassland knowledge has been, and is, almost wholly in the hands of the Department of Agriculture, which is the only organization that has the widespread direct contact with the farmer that is so essential in the successful carrying-out of such work. Further, a substantial amount of grassland research work is conducted by the Department of Agriculture, which, however, shares this research work with several other institutions. Linked with this sharing of research work among several institutions is fragmentation of effort.

Evidence of this fragmentation of effort is by no means scarce. We have, for example, at least four chemical research units working on lime questions; at least three organizations dealing with strains of pasture species, and similarly in regard to top-dressing, utilization, and other grass-farming matters. Mere fragmentation is not a weakness, but it frequently means that some matters are wastefully duplicated or that some are neglected. Hence its presence makes one suspicious of some loss of efficiency and of economy. Fragmentation of effort is particularly likely to be disadvantageous when there is multiplicity of control as there is now in New Zealand grassland research. With multiplicity of control there is likely to be absence of any binding authoritative influence to ensure that eventually the fragments may be cemented into a useful whole.

Possible Means to Control examined.

It is in the interest of New Zealand that the binding influence should be supplied. In view of the fact that the Department of Agriculture is already responsible for the major share of the work of grassland advancement it would seem logical and businesslike to make the Department responsible for the remaining share, and all evidence suggests that this would be the ideal remedy for our present weakness in the organization of grassland work. Such a course would enable the advancement of grass-farming to be fostered not piecemeal, but as a commercial and biological unit or whole. Such a course, though the ideal one, may however be ruled out as impossible in view of financial and staffing arrangements already made in respect to other organizations. The position is a repetition of the old saying that it is not easy to replace an established arrangement even by one which promises to give better service. Assuming that the placing of all grassland work

under the Department of Agriculture must be ruled out, it becomes necessary to ask what alternative type of organization would be an improvement on the present state of affairs.

The vital point in an organization is its control; unless the control or direction is suitable the whole structure is likely to crash. Two main types of control of grassland work suggest themselves as alternatives to control by the Department of Agriculture. The first is control by a new grassland institute. The second is control by the present directing bodies supplemented by an agency fitted to foster exchange of views and experiences, and to stimulate general co-operation and co-ordination in the activities of these bodies.

The grassland institute as usually proposed would be representative of farming, commercial, and scientific interests. It would become responsible for the drafting of the programme of grassland work. It would, as a rule, merely supervise the carrying-out of the work which would be delegated to the various organizations already doing such work. The creation of such an institute would have the following decidedly advantageous results:—

(1) It would give the unity of direction which eliminates loss of economy and efficiency, and which tends to proper balancing of the various aspects.

(2) It would assist in ensuring that grassland work received the attention its national importance warrants, in that the institute would naturally try to recruit all possible interest and assistance.

(3) It would, to some extent, remove the work from the influence of politics, particularly if, as the advocates of the institute contend, funds would be forthcoming by levy or contribution from the interests most directly served.

The weakness of such a grassland institute, as has been outlined, is that if it contented itself with delegating to other bodies the carrying-out of grassland work it would have no power to enforce its findings relative to such work. When it suited them these other bodies would obey the wishes of the institute, but not otherwise. This weakness is so serious and fundamental that the mere statement of it would probably be sufficient to damn such an institute in the mind of the public. It reduces the institute to an advisory status. It may be contended that a grassland institute is so inherently sound that it would operate smoothly, so that the development of such a weakness in practice would be a remote possibility, and that in case of such a development it would be open for the institute to remedy the position by carrying on its programme of work instead of delegating it. Thinking along these lines combines specious optimism with a replacement of the original proposal by another one possessing its own weakness. Once a grassland institute embarked on the executing, as distinct from the planning and supervision, of work it would open itself to the charge of being simply an addition to the organizations it set out to unify, and thereby it would provide an admission of having failed dismally in its essential purpose.

To all the points already raised it may be objected that nothing has as yet been advanced to contradict the view that the separate grassland institute in complete charge of all grassland work is the

ideal organization to meet the requirements of the present position. The reality is rather many miles away, but consideration will soon show that the operation of such an institute would be merely a duplication of the major portion of the extensive duties now being carried out by the research and instructional services of the Department of Agriculture. Why wherein such a duplication in the first instance, but the public, with considerable justification, would ask

Liaison Agency necessitated.

There remains one type of control to be considered. It consists of control by bodies of persons directly supplemented by a liaison agency hired to keep knowledge of them and experiment between interests directly concerned and to stimulate co-operation and co-ordination in effort. Such a liaison agency could probably be created successfully by the appointment of a special officer whose duties in a general way would be to keep both research and advisory officers in touch with the practical work being done throughout New Zealand. Such control could be most valuable, for it would tend to remove the danger, always present of isolated workers getting into grooves. It would probably be advisable to attach the liaison officer to the Department of Agriculture as that body has already in its hands much the greater part of the work of grass-farming advancement.

The work of such a liaison officer could probably include the following activities:—

1. Keeping all those engaged in advisory work provided with ready access to happenings in and around all recent developments in the research sphere.

2. Constantly keeping all those engaged in research work in the different districts fully acquainted with the more recent developments not only in the sphere of research, but also in the sphere of farm practice. A valuable influence of the liaison officer's knowledge of information which has and has previously remained entirely unknown would be the elimination of isolated individual effort which gives evidence of duplicating. Another influence would be the minimising of the danger of premature publication of efforts. All private work efforts of the organization are not always acquainted with what is being done or has been done in another organization. The danger is considerable. Another valuable influence would arise from the fact that better knowledge between the officers in regard to their work would almost certainly beget co-operation. For instance, it is conceivable that as a result of better all-round knowledge of what is being done in the grassland world, the district of one organization would see how to fit in its work more effectively with a portion of another organization and a field station of a third institution. In this way would arise between the institutions a valuable system of team work that would be a considerable step towards unity of action which would be welcome and incidentally somewhat unusual in a movement which works without any formal unity in direction.

3. Bringing about more complete contact between those responsible for advisory and research work on the one hand and those

directly interested in the results of that work, on the other hand—for example, farming, fertilizer, seed, and implement interests. From regular meetings of representatives of these interests could be organized a united movement to press the just claims of grassland work to a much greater attention than it is now receiving. To-day the interests mentioned have had no opportunity of framing a national grassland programme. A liaison agency could arrange for such an opportunity, probably by utilizing an association of workers. Further, possibly from such an association would come not only a policy, but funds to supplement those provided by the State.

In brief, the aim of a liaison agency should be to effect gradually the changes which some to-day would attempt to effect in a revolutionary way. It may be taken as a basis of practical planning that unless the state of affairs in the grassland world were very much worse than it is to-day the public that controls the purse would not support any radical changes. This may be partly illustrated by saying that no scheme involving the formation of a new comprehensive grassland organization would find favour. Likewise any scheme involving any other violent changes in our present activities, such as the concentrating of grassland work in the hands of some institutions and the dropping of other institutions from the work, would be resisted, and this probably with such success that the scheme would not be realized. It would seem that to be practical we must be content to proceed to a better organization of grassland work by evolution rather than by revolution. We must seek neither to create any new organization nor to eliminate from the work any organizations now participating in it. Rather the objective should be to work with all these organizations, extend their activities, and weld them into a well-balanced whole by authority arising spontaneously from within rather than by authority forcibly impressed from without. This course may by some be viewed disparagingly as a compromise. It is a compromise. But it is well to remember that it is practicable to deal with certain situations only by a compromise. In grassland work, if we ask for the ideal organization or nothing at all, we are very likely not to get the ideal organization. Why not accept a compromise, particularly if the compromise leaves open a way to improvement of the position later? The liaison agency is the compromise that seems to meet the present position. A weakness of the liaison-agency proposal is that a great deal depends on the person allotted the liaison work. However, this weakness is probably not as serious as some would make it seem, for is not the same weakness associated with all human endeavour?

The magnitude of the benefits that may reasonably be expected from full exploitation of our grass-farming, and the magnitude of the weaknesses and deficiencies both present and prospective which attach to our efforts and organization, justify the initiation of a movement which centres round a liaison agency, and which assumes the goodwill and hearty active co-operation of all institutions and persons interested in grassland advancement. If the liaison agency receives this goodwill and co-operation its success is assured. If it does not, there is something radically wrong, and the sooner this is exposed the better. A new structure could then be erected on a different foundation.

Summary.

The current grassland position in New Zealand is summed up in the following facts :—

(1) The standard of our grass-farming is relatively high, and for guidance to improved farming we must depend mainly upon ourselves.

(2) Full application of our present knowledge would most markedly increase our national production from grassland.

(3) The comparatively poor application of our present knowledge is due to several causes, including ignorance that information is available and hesitation to accept as reliable guidance the advice which is known to be available.

(4) In the framing of future work the practical farmer as a source of sound guidance should not be overlooked, for he has already proved his worth in this connection. Advice based on practical experience specially appeals to those seeking guidance.

(5) There is much scope for valuable research, problems of special importance being (*a*) grass-farm management as distinct from grass-production technique, and (*b*) technique of experimental method.

(6) The advancement of grass-farming is a unit task which calls for unity of control as the foundation of team work.

(7) Under present circumstances the ideal means to unity of control is the placing of all organized grassland work under the direction of the Department of Agriculture, but this course may be ruled out as impracticable.

(8) Other attractive methods of control suggest themselves, but prove open to serious objections.

(9) Probably the only practicable means of effecting greater co-operation in grassland work is a liaison agency.

The sources of all facts and opinions quoted are available. Much of the information quoted is from official sources, and when this is not so it is from authoritative overseas sources.

Dairies supplying Milk for Town Consumption.—There are now close on 5,000 dairies registered for the supply of milk to towns throughout the Dominion, of which 2,193 serve the four larger centres. Referring to the subject, the annual report of the Live-stock Division for 1930–31 states that during the last few years a considerable advance has been made with regard to the type of dairy-shed being erected. The old type of shed, which on account of its construction was difficult to keep in a sanitary condition, is fast disappearing, and new structures built on sanitary principles are being erected, with the result that the farmer is supplying a better commodity than he was able to previously and with less trouble to himself. With regard to the health of cows in registered dairies, that has been well maintained. All animals are regularly inspected, and any suffering from disease are condemned or isolated. In addition to this the tuberculin test has been freely applied and all animals reacting thereto are forthwith destroyed. Further, composite samples of the milk are taken from a number of herds and subjected to a biological test, and should there be positive results the various members of the herd are tested individually. The health of the herds and the standard of cleanliness of the sheds and surroundings are being well maintained.

PRESENT-DAY KNOWLEDGE OF YOLK IN WOOL.

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THE following article is an attempt to bring before sheep-breeders in a readily available form the present-day knowledge of wool yolk—its production, function, and importance in the fleece. In the past a great deal of circumstantial evidence on this subject has been collected, mainly as a result of observation in the field. The ideas of different breeders do not always agree either in principle or detail, but the widespread interest in the subject indicates its importance to the wool-growing industry. Within the last few years a considerable amount of research work has been carried out with the object of discovering the precise nature and effect of yolk. The results of this and similar work will in time provide a basis of exact information to which the ideas of practical men can be related, and from which suggestions can be made towards the most effective management of yolk for the production of better wool.

The fleece of the sheep may be considered as consisting of two components—wool and yolk. In the past the manufacturers have regarded yolk as a necessary evil. Yet it is significant that the breeder, who has to consider the wool fibre not as a finished article but as the result of many interacting influences, has not attempted to reduce the amount of yolk in the fleece by selection or breeding. In his mind yolk is given a very important place among the agents affecting the wool fibre, and in general he aims at a plentiful supply of medium-coloured and easy-flowing yolk. Indeed, we have to-day Merino sheep which produce a fleece containing more yolk than wool. This article will endeavour to state what has been learned of the foundation on which the practices of breeders rest.

The abundant occurrence of yolk in the fleece has led to some utilization of the substances occurring in it, in an effort to make yolk an asset rather than a liability. The manufacture of lanoline ointment by purification of the waxy portion of the yolk, which floats on the surface of the scouring-liquors, is an important industry, since lanoline forms the base of many cosmetics and ointments. In some countries potash for use as a fertilizer is recovered from scouring-liquors. Owing to the vast bulk of liquor which has to be handled, this can only be done economically where the wool industry is concentrated within a small district. In England at present efforts are being made to find new uses for yolk and the substances derived from it. One of the most important developments is the use of yolk in place of soap as a scouring-agent. Yolk contains large quantities of natural soaps, and it has long been known that when a certain amount of wool has been put through a scouring-bath the scour becomes more effective, due to the accumulation of yolk in the bath. By the use of settling-tanks to remove dirt and centrifugal separators to remove wax a process has now been devised by means of which it is possible to scour wool by the use of yolk alone. However, such attempts to utilize yolk appear to be merely making the best of a bad job, and by themselves could never be sufficient excuse for the continued production of large quantities of yolk in the fleece.

Further developments cannot originate from the manufacturer, who takes wool as he finds it—that is, laden with yolk—and must utilize it in the most profitable manner.

The wool-grower, on the other hand, has at his command the opportunity to change or improve the fleece in almost any required direction, so that he views the fleece from an entirely different angle. The intimate association of yolk and wool in the fleece immediately suggests the possibility of some essential connection between these two materials. This is a point of considerable importance to both manufacturer and producer—firstly, because the yolk has to be removed by an expensive process before the wool can be utilized; secondly, because the yolk has to be transported with the wool for long distances at considerable cost; and, thirdly, because the production of large quantities of yolk by the sheep must involve the use of energy which might otherwise be devoted to the production of wool. Wool-scouring, like many other trade processes, is an art rather than a science. Its expert performance is based on long practical experience rather than on exact knowledge, and its manipulation to produce any desired results is so closely connected with the use to which the wool is to be put that many manufacturers maintain that it can be carried out satisfactorily only by the subsequent user of the wool or by some one in close contact with him. On these grounds any scheme for carrying out wool-scouring in the producing countries is unpopular with the manufacturers. The value of the by-products recoverable from yolk is not sufficient to meet more than a fraction of the charges for transport and removal. Has the yolk, then, any value in its effect on the fibre sufficient to make its continued production in large quantities in the fleece an economically justifiable procedure?

Since the manufacturer determines the price of wool paid to the producer according to its suitability or otherwise for his requirements, it is well to consider yolk content from the manufacturer's point of view. It has long been realized that a certain small amount of yolk is necessary for the satisfactory processing of the fibre, for the complete removal of the yolk leads to grave difficulties in some of the mechanical processes. This necessary amount is, however, very small—approximately ½ to 1 per cent.—so that it would appear from this point of view that fleeces might very well be grown with much less yolk than is the common practice. Further, we find that it has come to be recognized that a wool with a sufficiency of yolk evenly distributed along the length of the staple tends to be a more even and better spinning wool. Also a good distribution of yolk is a sign of a sound wool. In a somewhat similar manner wools with a good yolk-supply tend to have a better handle, since handle appears to be associated to some extent with evenness.

These views have received interesting confirmation from some work published by Winson[1] in 1929. Working with Australian wools from the same source and ranging from 56's to 64's quality, and two samples of a 50's New Zealand crossbred wool, he compared samples heavy in condition with those containing only a small amount of yolk. The samples had been sorted by Bradford sorters, so that a high degree of correspondence could be expected. He found that the greasy samples differed from the samples of the same quality, but with a

lower yolk content, in that (1) the fibres were definitely finer; (2) in most cases the samples were more uniform in their diameter—that is, there was less variation in the area of cross-section of the fibres; (3) in every case the fibres of the heavy-conditioned wools were more nearly circular in cross-section; and (4) in all cases the variation in shape of cross-section in the fibres of the heavy-conditioned wools was less.

The first two facts make for higher spinning-capacity, while experiments have shown that a high degree of circularity in fibres is also desirable. Obviously, therefore, the wools containing plenty of yolk were more desirable from the manufacturing point of view than those with less yolk. Whether the good wool and the plentiful supply of yolk both resulted from the same underlying cause, or whether the yolk was a contributory factor to the excellence of the wool, remains to be shown. In either case the yolk was at least an indication of the character of the wool, a conclusion at which breeders had arrived independently by practical observation.

In spite of the recognized value of yolk as an indication of the characteristics of the wool with which it is associated, buyers have had a tendency to penalize wool very heavy with yolk, and especially so if that yolk were deep in colour. This attitude has probably arisen from the difficulties encountered in dealing with "canary stained" wool and wools with other abnormal yolks, such as "cakey" yolk, "dead" yolk, &c. In an investigation into the causes of some of these abnormal yolks, a preliminary account of which has recently been published, Rimington and Stewart(2) have made an attempt to determine whether this attitude was justified. It should first be mentioned that an expert can distinguish between these abnormal conditions, such as "canary yellow," and the more normal highly coloured yolks, so that any tendency to penalize coloured yolks because of their superficial resemblance to such abnormal yolks is difficult to justify. Rimington and Stewart found that the condition known as "dead yolk" is completely removed by ordinary scouring methods. In addition they collected samples of wool with yolk varying in colour from bright white to a deep yellow-brown. These samples were scoured normally and then rearranged in order of brightness by various independent experts. It was found that the wools which before scouring showed a deep-coloured yolk were placed first, while the sample showing the greatest brightness before scouring now came fifth. Obviously, then, highly coloured yolk is at least no disadvantage. "Cakey" yolk, on the other hand, though it scours out quite readily, yet because it has not been able to flow evenly along the wool fibre, is not generally associated with the most desirable type of wool.

Furthermore, Hirst(3) has shown that the colouring-matter of the yolk acts as a protective agent against the harmful effects of exposure to ultra-violet rays, some of which occur in sunlight. The effect of such light, working in conjunction with the atmosphere and moisture, is to change the chemical nature of the wool-fibre, as can be seen in the brittle tips of wool inclined to be "tippy" and lacking in yolk in the outer part of the staple. From work done at this College and elsewhere it has been shown that such dry and "tippy" wool dyes

unevenly, the weathered portion of the fibre taking the dye more readily. The development of an adequate supply of yolk will do much to overcome this deterioration.

Work at Massey Agricultural College.

Considering the evidence quoted above, it can be seen that the amount and nature of yolk produced in the fleece is a question of considerable importance and one to which wool-growers might well pay more attention in the future than they have in the past. The growing realization of this fact led to the undertaking of some work in this connection at the Massey Agricultural College, with some assistance from the Department of Scientific and Industrial Research. The paucity of information available on the subject may be gauged from the vague nature of the original plans, which stated that the

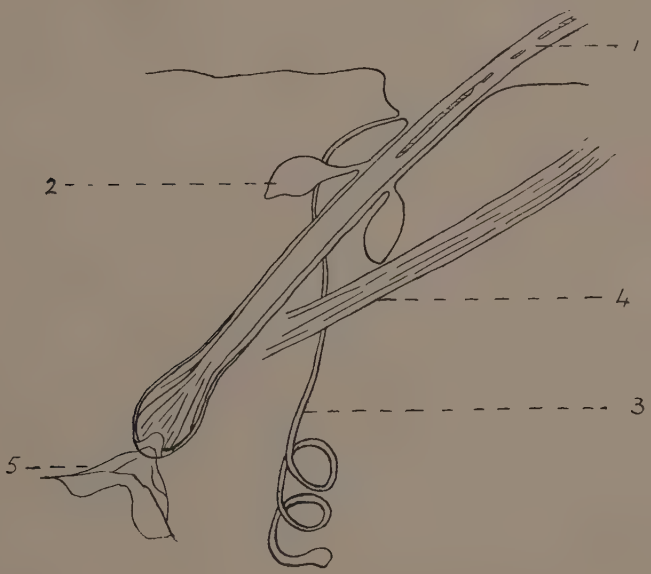

DIAGRAM OF WOOL FOLLICLE.

(1) Fibre; (2) wax-gland; (3) sweat-gland; (4) muscle; (5) blood-vessels.

work was to be an endeavour to discover what, if any, was the connection between yolk and wool on the one hand, and between yolk and feed and weather on the other hand.

The yolk as it occurs in the fleece consists of the products of two sets of glands in the sheep's skin—the sweat-glands such as are found in the human and other animal skins, and special wax-glands which have a somewhat more intimate connection with the follicle in which the wool-fibre grows. This juxtaposition of the follicle and the two types of glands would seem to indicate the probability of a connection in their function (see diagram).

The wool-fibre as it grows up from the root of the follicle is complete in its elaboration before it reaches the surface of the skin. Just before emerging from the mouth of the follicle it passes the openings of the wax-glands and receives a coating of wax. At the skin-level it emerges into a small depression into which the sweat-gland, if one be present, discharges its secretions. Thus it is seen that the fibre becomes completely covered with wax and sweat. It should be noted that though the term "wool-fat" is frequently used in referring to the product of the wax-glands, this material contains no fat, but rather resembles wax such as beeswax in its chemical composition. This composite coating is what is known as yolk. Since the yolk is applied to the outside of the already completed fibre, its function would appear to be a protective rather than a nourishing or building one.

However, a certain amount of yolk probably penetrates from the outside into the interior of the fibre by way of the pores between the cells which make up the fibre, and acts as a lubricant there as on the outside, maintaining the pliability and elasticity of the fibre([5]). These pores are not normally visible, but on extracting the fibre very thoroughly with solvents which remove the wax they become visible under the microscope. This yolk which penetrates to the interior of the fibre constitutes the greater part of that which the manufacturer leaves in the fibre after the scouring process. In addition to acting as a protective agent against light, weather, &c., the yolk on the exterior of the fibre acts as a lubricant to prevent loosening or removal of the scales by rubbing against other fibres. Such damage when it occurs results in weaknesses in the fibre and uneven dyeing. A preliminary investigation of the exact protective action of yolk on the growing fleece has been started at this College, but has not yet reached the stage at which results are available.

Wax-glands are connected with every follicle, though their numbers and size vary from follicle to follicle. Sweat-glands, however, occur with limited numbers of follicles only, the proportion of follicles thus equipped varying probably in different parts of the skin of each sheep, and certainly in the skins of different sheep. There is a suggestion from some of the biological work at the College that sweat-glands may occur only in conjunction with certain types of fibre, or with fibres which appear before a certain stage in the lamb's development. As these types of fibre play a very important part in the development of the fleece, it may well be that differences in yolk are associated with differences in type of fleece. As yet too little is known about the relations between different fibre-types and their successors in the mature fleece for us to do more than speculate on this possibility.

The sweat-glands are extremely interesting, and as yet comparatively little is known of their functions. They resemble the kidneys to some extent in their function, since they remove waste products of the body from the blood. In the event of a breakdown in the kidneys, or in certain other abnormal conditions of the body, the sweat-glands have to take over an additional part of the load. This occurs in certain human diseases, for example, and presumably therefore in the sheep also. In addition, it has been shown that the sweat-glands secrete a colouring matter resembling the substances which give urine and bile their colour. This colouring matter is responsible for the colour of

normal yolk. It is probable that by some derangement of the activity of the sweat-glands they can secrete colouring matters which permanently stain the wool, just as urine stains it, thus rendering the wool unsuitable for many purposes. In view of the maze of channels through which wool passes between buyer and clothmaker, such wool would be discounted in price even though it were ultimately to be used for some purpose for which its stain was no disadvantage. However, even if this defect in the buying system were corrected, such wool would still be debarred from some of the most profitable branches of the trade.

The wax-glands appear to be much less variable than the sweat-glands. This is probably due partly to the fact that they are special glands evolved solely for the purpose of making wax for the wool-fibre, while the sweat-glands, as accessory excretory organs, are liable to be called upon for any odd little job in the way of removing waste products from the body. The well-known use of the sweat-glands to control body temperature, by secreting moisture which evaporates from the surface of the skin and cools the body-surface, is also a variable one, as such cooling is only required when the body becomes overheated because of a high air-temperature, vigorous exercise, or feverish conditions. But, even assuming less diversity in the character of the product of the wax-glands, there is still considerable variation in secretion, at least in amount, at different times of the year and under different conditions, as has been shown by the present writer and others.

We have seen that there are differences in numbers of both wax and sweat glands in different parts of the same sheep and in different sheep. These numerical differences and differences of size will explain a great deal of the variation in amount and type of yolk. Such variations of yolk are well known to all those interested in wool, but whether these variations are in any way linked with the type of fleece or are partly responsible for the type of wool produced is not known. This is a difficult problem on which it is hoped to shed some light in the future. The difficulty of solution is increased by the fact that the same part of the same sheep under different conditions of climate, feed, health, &c., will produce yolk varying in amount and composition as widely as do two yolks from different types of fleece. Very considerable variations occur in this way from month to month, and possibly almost from day to day, so that apparently yolk is relatively easily affected by both hereditary and environmental factors. If, then, it could be shown that yolk played an important part in determining the characteristics of the wool with which it is associated, an extremely valuable method of wool improvement might be developed.

In such an event, however, there would still be difficulties to overcome. Work done at the College has shown that in certain types of fleece it is difficult even for the expert to estimate the amount of yolk present. The difficulty of estimation of yolk by sight and touch alone, as in the fleece while still on the animal, is due to several causes. The temperature of the air has an important effect, as higher temperatures make the yolk more fluid, and there is then a tendency for more yolk to cling to the fingers. The moistness of the atmosphere also has a considerable influence on the wetness of the yolk, as some of the substances in yolk have the property of absorbing large quantities of moisture from the air. Both the appearance and the feel of the yolk depend to a considerable extent on the relative proportions in which wax and

sweat are present, and the appearance is also influenced by the amount of colouring matter present. As a result of these various effects, it is desirable that some method of estimation independent of sight and touch should be used wherever possible. A satisfactory laboratory method for the estimation of yolk has been devised, and possibly if the necessity arose a suitable field test could also be devised.

In determining the actual composition of the secretions of the two types of gland, it is generally assumed that the water-soluble material is chiefly secreted by the sweat-glands, while the material insoluble in water but soluble in certain other solvents, such as ether, is produced by the wax-glands. That this broad but convenient distinction is somewhere near the truth is shown by comparison with the skin secretions of animals which have only one type of gland on the greater portion of their bodies—the human skin, for instance, having chiefly sweat-glands. The waxy portion of the yolk—the secretion of the wax-glands—consists chiefly of a substance called cholesterol and other similar substances. Cholesterol though insoluble in water readily forms an emulsion with it. Thus lanoline is an emulsion of the wax in water. The sweat, or "suint" as it is often called, is composed principally of potash compounds with certain natural acids, such as stearic acid. These compounds are soaps, and hence soluble in water. They probably aid in the emulsification of the wax, soaps being good emulsifying agents.

The relative amounts of sweat and wax vary considerably. Wax may occur to the extent of from 2 to 60 per cent. of the raw wool, while the sweat content varies from 2 to 20 per cent. The sweat commonly contains about 60 per cent. of potash. It is interesting to note that New Zealand annually exports from 4,000 to 5,000 tons of potash with the wool-clip. It is not possible to recover all this potash from the scouring-liquors. In commercial practice yields of 30 lb. of potash salts suitable for fertilizer are obtained from 1,000 lb. of raw wool. The potash as recovered commercially is mainly in the form of carbonate.

The writer has found in a fairly even Romney crossbred flock variations from 7 to 26 per cent. in sweat, and from 3 to 15 per cent. in wax content. These values all refer to the wool on the middle of the side. Variations almost as great as these occur in different parts of the same fleece, while all breeders are familiar with the phenomenon known as "rise" of the yolk. This more or less sudden appearance of heavier condition in the fleece is probably due to two factors: (1) The production of an increased amount of yolk; (2) the increased fluidity of the yolk.

There is some evidence to show that the increased production may occur some time before the "rise" becomes evident, but only becomes apparent when the yolk becomes more fluid. The increase in fluidity is due on the one hand to warmer temperature making the wax softer, and on the other hand to the amount of water absorbed by the sweat. Sweat has the property of picking up moisture from the air, so that if a dish of dried sweat is exposed to the atmosphere it will within a few hours absorb enough water to become dissolved. The temperature and moisture factors between them account for the difference in appearance and feel of yolk even on consecutive days, not only in the fleece on the sheep's back, but also in wool left in bins, where there can be no question of change in the amount of yolk present. This is also the explanation of

the difference in appearance between a long "locky" hogget fleece, in which the wool is exposed to the drying action of the wind (and to a certain extent to leaching by rain), and a closer ewe fleece, in which the maximum amount of heat and moisture is retained.

The amount of yolk actually present in a fleece under ordinary conditions represents the difference between the amount produced by the sheep's skin and that leached by rain or otherwise removed. The amount of leaching and removal by other forms of weathering is dependent on the size of staple, openness of the fleece, the efficiency of the fleece as a thatch, and the type of yolk present, even under similar conditions of weather; so that in order to obtain for experimental purposes a reliable estimate of the yolk production of the skin, protection from the weather is essential. This is doubly important, as the leaching removes a greater proportion of sweat than of wax.

The writer([4]) has shown that covering with a light waterproof cover is a suitable method of protection. It is interesting that even in hot summer weather the covers did not increase the amount of yolk, but merely increased its fluidity. As a result, the appearance of the wool of the covered sheep was considerably improved, even as compared with the uncovered sheep which never got wet, and so had just as much yolk but not such a good distribution of yolk. Another difficulty arises from the variations which have been pointed out above—variations in different parts of the same fleece, in the same part of different fleeces, in the same part of the same fleece from time to time—variations which express the interworking and interdependence of an unknown number of factors of heredity and environment. In fact, the problem, dealing as it does with living animals, shares all the difficulties common to biological problems, difficulties which arise from the fact that no two animals are alike.

The solution of this puzzle involves the use of averages from large numbers of animals sampled at frequent intervals under conditions as carefully controlled as possible. With the sheep it is not possible to control environmental conditions as closely as can be done with smaller animals, nor is it possible to produce such a uniform line of animals as can be done with more rapidly breeding small animals such as guinea-pigs and rats, which are frequently used for experimental purposes. The only method is the treatment of sufficiently large numbers to give a reasonable accuracy. It is possible to calculate the accuracy of a set of results, and thus keep a check on any conclusions that may be drawn.

In spite of the long and laborious nature of the work, and the limitations due to circumstances over which the worker can have no control, stimulating and interesting results are already appearing—results which when critically examined suggest numerous and useful lines for further work.

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FEEDING OF PIGS IN DAIRY DISTRICTS.*

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WHILE much or all of what is now said may not be new, it is felt that restatement is justified. One so frequently encounters losses of pigs attributable to faulty feeding, or farmers who have become discouraged or have abandoned pig-keeping as a result of such losses, that it would seem that available information has been overlooked or disregarded.

It must, of course, be admitted that there is still much to be learned as to comparative costs of various feeding methods, comparative qualities of pork or bacon thus variously fed, and particularly as to comparative value, from the point of view of quality and economy, of different strains and first crosses of the various pure breeds. It is confidently hoped that the valuable work now being done by the Pig Recording Committees will yield this information. It should be stated here that numerous points in this article have been derived from experiments carried out by Mr. Peirson, Recording Officer for the Waikato Committee.

One general statement to be made is that it pays the farmer to breed his own pigs. Records of costs show that the weaner can be produced on the farm at a cost much less than that which has to be paid in hard cash on the market in the spring. The satisfactory profit made by those who breed and sell their weaners is also proof of this. The objections to the alternative of going on the market for weaners are several. Usually, at the time when one wants to buy weaners in readiness to deal with the surplus of skim milk or whey, a similar want is felt by all the would-be feeders at once, so that weaners bring high prices, up to as much as 25s., thus leaving a narrower margin of profit when they are turned off after three months' additional feeding. Also, there is the ever-present risk of introducing disease with market purchases, and the frequent chance that unless one has had previous experience of that breeder's pigs they may prove of unthrifty strain or defective conformation.

COMPOSITION OF FOODS.

All our common foodstuffs are combinations in various proportions of five ingredients: (1) Proteins, which are the nitrogenous and flesh-forming elements; (2) carbohydrates, the fat-forming and energy-producing substances, including starches and sugars; (3) fats, somewhat similar to carbohydrates; (4 and 5) vitamins and minerals, which are essential to life, growth, and health.

It is the variation in proportions of these five substances which, apart from digestibility, largely determines the value of the different foodstuffs in various stages of the animal's growth. The animal body calls for a wide variety of substances, and therefore, in general, a diet including a number of foodstuffs is more likely to include all the substances necessary for growth and health than a diet comprised of one foodstuff.

* Substance of a radio broadcast lecturette.

The proteins are the most complex and perhaps the most important elements, and include a greater variety, there being, for instance, at least twenty different types of protein in milk. Proteins are chiefly important to young growing animals, and only little less so to pregnant and milking animals. With the trend of present fashion among flesh-eaters of the human race towards lean meat and preferably young lean meat, and away from the fat-laden bacon, mutton, and beef of the past, it would seem that protein substances must become of greater importance in the diet of young animals fed for meat.

Examples of protein-rich substances are lean meat, and therefore meat-meal; casein of milk, present in whole and skim milk; young growing grass; and certain meals such as linseed and pea-meal. Protein substances are usually expensive, and it is fortunate for the pig industry in the dairy districts of New Zealand that abundance in the form of skim milk is available during spring and summer. It is an interesting comparison with pig-feeding methods in the United States of America to note that there, with cheap grains, milk is regarded in the grain belt as a valuable supplement. In New Zealand, particularly in the North Island pig-feeding districts, milk is cheap and plentiful, and grains are used with discrimination.

Carbohydrates, present in all foods, preponderate in the tubers such as artichokes and potatoes, certain meals such as maize, and in milk sugar (in whey) and molasses. Excess of carbohydrates is stored up as fat, and it is recognized that the nature of the food can influence both amount of fat and its quality as to firmness, &c.

Fats and oils are present in minute amount in most vegetable feeds. Certain oils fed as such have feeding-value, but there is always danger in feeding animal fat or oil to pigs later to be used for bacon, because this is stored up in the body and retains any taint or odour for a considerable period to the detriment of the quality of the meat.

Minerals.—The importance of a proper supply of minerals in the diet of all animals is now generally recognized, and this applies fully to the pig. Sows' milk is particularly rich in lime, the percentage being nearly three times that of cows' milk. Definite experimental proofs have been given that shortage of calcium leads to reduced rate of growth in young pigs and to defective bone-development, and that phosphates are equally important. Definite disease attributable to calcium deficiency does not seem prevalent in New Zealand, but much of the often-seen unthriftiness in weaners may be related to some mineral deficiency. Anæmia of suckling pigs, believed due to insufficiency of iron in the mother's diet prior to farrowing, is said to be frequent in the United States, but has not been recognized here to any extent, nor is it likely to occur where the sows are pastured rather than kept in sties. While a properly balanced diet will contain sufficient minerals, if this is at all in doubt the use of small amounts of bone-flour, together with meat-meal which supplies iron and phosphorus, is advisable.

It may be reiterated that shortage of protein or mineral is less likely to occur where the diet is varied—that is, includes several types of foodstuffs. Not only this, but experiments show that the addition of a small quantity of a second foodstuff to one fed as sole diet leads to more complete digestion and utilization of the main foodstuff, and is thus economy.

Feeding the Pregnant Sow.

The production of the first crop of healthy weaners ready for the new season's dairy by-products is the farmer's aim. The first sows should farrow about the end of June, and the first young-litter sows should come along later—say, in August—and will help to fill the gap. These dates may apply more particularly to the Waikato area. Attention to feeding must commence with the sows before farrowing, and one can state in general terms that she should have sufficient protein and mineral. When a certain amount of skim milk is available this supplies protein, but considerable mortality has been observed in the litters of sows fed with plenty of skim milk and little else. Meat-meal at the rate of 1 lb. per day or less, depending on the sow's condition for a month before farrowing, has been found an excellent supplement to skim milk, or, indeed, to any winter diet.

The sow is best left with as free a range as possible. By bringing the sows in early there should be no difficulty in getting two litters a year, and of disposing of the second one before the end of the season.

Feeding and Care of the Litter.

Mortality in the baby pigs is one of the serious losses to the industry. Feeding and cleanliness will do much to reduce it. Whether the sow is farrowed in a clean grass-yard, with an open portable house, or is confined to a proper farrowing pen, will depend largely on the locality and nature of the soil, drainage, aspect, and shelter from prevailing winds. While one prefers to see the sow in a sty, nicely bedded, and the young ones snug and warm, it was observed recently in one piggery that diarrhœa was a constant trouble with the week-old piglets. Modifications of the sow's food did not appear to influence this until the method was changed and the sows farrowed in clean grass-yards. Apparently an infection in the sties was responsible. It is not, of course, intended to advocate a liberty-at-any-price system, and allow the young pigs to be trailed in mud-covered areas around the cow-yard. The sow should be kept a little short for twenty-four hours after farrowing.

The use of the creep system, whereby by means of a hurdle across the sty or use of an adjacent sty the young pigs are allowed access to a small trough of their own, makes the weaning easy and almost automatic, and has been shown repeatedly to produce heavier piglets at eight weeks.

A scale of feeding found by the Waikato Committee's recording officer to answer well is to start with 1 oz. of meat-meal per piglet, added to a little skim milk; at three weeks old increasing to 2 oz.; and to ¼ lb. at eight weeks, by which time he is weaned. The total cost for meat-meal up to this age, including that fed to the sow before farrowing, will not exceed 1s. 10d. per pig.

As soon as the little pigs are taking the meal, the allowance which up to this time has still been fed to the sow, along with skim milk, and roots if available, is cut out. Feeding of the sow before farrowing and of the litter in the first eight weeks constitute the important factors. It has been found that whatever weight the pig is at this stage he will be two and a half times as heavy in sixteen weeks. The production of 40 lb. weaners at eight weeks has been achieved in over 50 per cent. of the litters recorded last season by the Waikato officer.

Before, and particularly after, weaning the young pigs should be fed little and often. Their troughs should be of a suitable size, and they should not be allowed to gorge themselves, or digestive troubles will result. Good-quality grazing becomes valuable at this stage, but the pigs should be in small lots of six to ten, otherwise they soil feeding places and yards. Meantime, besides the meat-meal, pollard, ¼ lb. of each, is added to the milk or whey, and this is gradually increased to ½ lb. of each at ten weeks, at which age the pigs should be about 80 lb. porkers.

Feeding of Baconer Pigs.

While the production of pork is usually the most payable proposition, it sometimes suits the farmer to carry on certain pigs to use up milk, or he may have pigs carried through the winter to fatten. One sees pigs approaching the bacon stage confined to sties, and getting skim milk or whey alone, apparently thriving and growing, though being fed in defiance of the principles here advocated. A small addition of a meal mixture—say, pollard, maize, and meat-meal—would result in much better use being made of the basal food, which would be more completely digested, and it would also mean a better quality of bacon. If the pigs have no grazing, the addition of a little green food, such as peas or clover, helps to maintain health.

Winter Feeding of Store Pigs.

The farmer may be left at the beginning of winter with a number of unfinished pigs, for which the price at that season is very small. Articles by the Live-stock Division's Instructor in Swine Husbandry have pointed out that such pigs may quite profitably be carried through on a diet of roots—artichokes, turnips, or mangels—with a little freedom of range, shelter, and ½ lb. of meat-meal per day.

A recent experiment supervised by Mr. Peirson may be quoted in illustration: Nine pigs on artichokes plus ½ lb. meat-meal per day showed a total gain of 181 lb. in fifty-six days, consuming 252 lb. of meat-meal and bone-meal. With eight pigs on artichokes alone the experiment had to be stopped at thirty days, as the pigs were losing condition and showed a loss of 36 lb. in that time. As weaners in May were worth 3s. to 4s., and stores in August were worth 35s., the cost of meal was well repaid.

Further trials recently published by the Live-stock Division show that with winter store pigs having a run on grass, plus ½ lb. meat-meal, as against a control lot getting grass and ½ lb. meat-meal and ½ lb. barley lightly crushed, the lots showed a daily gain of 0·385 lb. and 0·453 lb. respectively, and it was considered that the addition of the barley meal was not economical. In a second trial chopped ensilage (some being lucerne and some grass) was fed, just under 5 lb. per day, together with ½ lb. meat-meal and a run to grass; the ensilage was shown to have feeding value and to be relished by the pigs.

Conclusion.

It pays the farmer to breed his own pigs. Proper feeding of the sow before and after farrowing, cleanliness, and the use of the creep system will help to cut down infant-pig mortality, and will give the 40 lb. weaner, which is profitable. Variety in the diet is relished by the pig as much as by ourselves.

CONTROL OF CLUB-ROOT.

EXPERIMENTS WITH LIME AND FERTILIZERS.

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LIME has long been advocated overseas as an effective controllant of club-root, but prior to the commencement of investigations in 1928 it had failed to provide a satisfactory control in New Zealand. The work at Palmerston North has shown in both small-plot and field experiments, first, that applications of burnt lime in quantities which the farmer can afford will provide a practical control of club-root; secondly, that the value of lime as a club-root inhibitant may be lost by drilling seeds in contact with superphosphate, basic super, a mixture of super and carbonate of lime (half and half), or special turnip manures composed largely of super; and, thirdly, that to procure an effective control with lime the fertilizer applied with the seed must be of a strongly basic nature, preferably basic slag or a mixture of equal weights of super and slaked lime. It is clear that the practice of sowing seed in contact with super and special turnip manures has, in the past, obscured the value of lime in reducing the attacks of the disease.

EXPERIMENTAL EVIDENCE.

From experiments conducted at the Plant Research Station it would appear that liming may not always prevent the development of the disease, but attacks may be so reduced that the majority of plants will develop normally. Apparently time must be allowed for the lime to penetrate to the deeper layers of the soil in which the roots grow. When penetration was incomplete infections frequently occurred at a more or less uniform depth some inches below the surface of the soil. This type of infection was fairly common in soil limed two or three months before sowing the crop, while in unlimed areas practically all the plants were attacked at the level of the soil surface. The odd infections that occurred twelve months after liming were all fairly deep in the soil.

The greatest damage results when club-root infection occurs at soil-level, as the disease interferes with the transportation of foodstuffs from the roots to the aerial portions of the plant. Sometimes swede and turnip seedlings overcome infection at soil level, but a lesion remains in the skin of the bulb, permitting the entry of putrefactive bacteria which render the bulb useless. Infections at depths of several inches, however, are of less importance, as there are usually many undiseased roots by which the plant may be nourished.

When club-root developed on soil dressed twelve months previously with 1½ to 2 tons of burnt lime per acre the infection was usually of the latter type, provided the crop was sown with basic slag. When the crop was sown on similar land with super, club-root developed almost invariably within an inch of the surface, thus clearly demonstrating the disadvantage of sowing super on limed infected soil.

FIG. 1. CLUB-ROOT INFECTION ON ODD RAPE PLANTS AT DEPTH BETWEEN 9 IN. AND 12 IN. IN SOIL LIMED TWELVE MONTHS PRIOR TO SOWING THE CROP.

When to apply Lime.

The experiments have shown that lime must be applied at least three months before sowing the seed. Time must be allowed for the lime to permeate the soil in which the roots will grow. When sowings took place too soon after liming, club-root was frequently observed at depths of 2½ in., 3 in., or 4 in. below the soil surface, the depth at

FIG. 2. SOME TYPES OF INFECTION OCCURRING IN UNLIMED SOIL—FOR COMPARISON WITH FIG. 1.

which it occurred varying with the quantity applied and the lapse of time between liming and seeding. After the lime had been applied for twelve months odd plots were found where the only infections were at 9 in. or 11½ in. below the soil-level. As indicated, to obtain practical control of club-root the lime must be applied at least three months or preferably twelve months before the crop is sown. It is essential that the lime should be intimately mixed through the upper layers of the soil in which the roots will grow.

Quantity of Lime to apply.

The quantity of lime necessary to control club-root will probably be found to vary in different districts, but in the experiments under review effective control was obtained by dressings of 2 to 3 tons of burnt lime or freshly slaked lime per acre, applied three months before seeding. Similar control was obtained by applications of 3 to 5 tons of carbonate of lime applied at a similar period before seeding. When lime was applied twelve months in advance of sowing, satisfactory club-root control was obtained with dressings of 1 to 2 tons per acre of burnt or freshly air-slaked lime, or 2 to 3 tons per acre of water-slaked lime. Applications of 3 to 5 tons of carbonate of lime per acre were somewhat less satisfactory than the burnt lime.

In some field experiments an effective control has been obtained with 33 cwt. of burnt lime per acre, harrowed in three months before seeding. The present evidence from field experiments at both Palmerston North and Gore* would appear to indicate that 33 cwt. of burnt lime per acre applied three months before sowing is the minimum application that will effect a practical control of the disease.

Seeding and Selection of Fertilizer.

It is the selection of the fertilizer with which the seed is sown that largely determines whether club-root will be controlled or not by liming. Lime does not kill the spores of the club-root organism, but renders the soil environment unsuitable for their germination. The sowing of an acid fertilizer in contact with the seed may, temporarily at any rate, neutralize the effect of the lime and make the soil conditions about the seed suitable for club-root development. Fertilizers which have been found to nullify the value of the lime as a club-root controllant are super, basic super, super and carbonate of lime mixture (half and half), and turnip manures composed largely of super. To ensure club-root control by liming, therefore, these fertilizers must be avoided. Basic slag or a mixture of equal parts by weight of super and freshly slaked lime have proved satisfactory and permit the lime to control the disease.

The following table illustrates the effect of the fertilizer on the control produced by lime :—

Treatment.	Percentage of Infection.	
	Seed drilled with Basic Slag.	Seed drilled with Super.
Control—no lime	59	95
3 tons commercial ground limestone ..	22	53
3 tons superfine ground limestone ..	10	87
2 tons air-slaked lime	0	78
2 tons burnt lime	0	36
2 tons water-slaked lime	3	82

* Gore Experimental Area : Report on Work in Season 1930–31. R. B. Tennent. This *Journal* for November last.

Conclusions.

From Britain we have long heard that club-root may be controlled by liming and also that the development of the disease is stimulated by superphosphates, but in New Zealand these two facts do not appear to have been considered together. In consequence the endeavours of farmers to control club-root with lime have failed through the practice of sowing super or soluble turnip manures in contact with the seed.

The experiments on which the findings here presented are based were conducted on small plots and confirmed by experiments laid down under farming conditions at both Palmerston North and Gore. In all cases it is shown that burnt lime in quantities the farmer can afford (33 cwt. to 40 cwt. per acre), applied at least three months or preferably twelve months before seeding, will control club-root, provided the effect of the lime is not neutralized by the use of an acid fertilizer when sowing the crop. Full details of the experiments are published in the *N.Z. Journal of Science and Technology*, Vol. 13, No. 2, Oct., 1931.

A STARTER PRODUCING BITTERNESS IN CHEESE.

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The flavour of Cheddar cheese can be influenced by so many factors that it is usually impossible to ascribe with certainty a single cause to any particular flavour. Various types of bacteria in the milk have been shown to induce distinct and specific flavours in the cheese, both desirable and undesirable. Typical of the undesirable types are the organisms of the colon group, which give a very marked unclean flavour to the cheese. Contaminating bacteria in starter cultures can also influence adversely the flavour of cheese. Feed flavours originally present in the milk are often evident in the immature cheese in spite of pasteurization and sometimes aeration. As the cheese matures they gradually change, in most cases, with the result that their identity is obscured.

But besides these factors, which constitute biological differences in the raw material of cheese-manufacture, it is possible to modify the flavour of cheese simply by a change in some detail of the process of manufacture. Such a change produces curd of a different nature, and, since the curd is the raw material of the ripening process, the whole course of the biochemical change which subsequently takes place may be modified. This may easily, and often does, lead to differences in flavour between cheeses made from the same milk and starter. A typical example of a change in the manufacturing process which induces differences in the cheese is a variation in acidity at any stage of the process—for example, the variations in acidity which result in the difference between characteristic Cheddar and Cheshire cheeses.

With all these separate and possibly interacting factors it is readily understandable that the causes of specific flavours are difficult to locate.

Judges of cheese frequently attempt to describe either the nature or the cause of abnormal flavours. A description of the nature is helpful to the maker in that he may from a knowledge of the milk, starter, and manufacture trace the probable cause, but it is seldom that it is possible for the judge of mature cheese to state definitely that a flavour is attributable to a specific cause unless he has a full history of the cheese. For example, metallic flavours commonly described almost certainly have no connection with contamination by metals.

Bitterness is a fault in flavour which is encountered quite frequently in cheese, and which can possibly arise from several causes. Harrison (1902) investigated a case of bitterness in cheese and showed that it was due to a torula (a yeast-like organism) which gained access to the milk on the farm and rendered the milk itself, and likewise the cheese made from it, very bitter. Hucker and Marquardt (1926) showed that the acid-liquefying cocci, a group of organisms which are thought to be present in small numbers in the udders of some cows, produce a bitter flavour in cheese followed by a softening of body. With regard to modifications in manufacture, it is well known that if milk is pasteurized at rather too high a temperature, so that a cooked flavour is evident in the curd, the cheese manufactured from it almost always develops a bitter flavour as it matures. During experimental work at this Institute it has often been noticed that some cheeses made from perfectly normal milk, not overheated during pasteurization, develop a bitter flavour at an intermediate stage in the ripening process. The bitterness subsequently disappears and the Cheddar flavour may develop normally.

The present article deals, however, with a type of bitter flavour in cheese which is evidently different from all those mentioned above. This particular bitter flavour appeared to be associated quite definitely with the use of a particular starter culture, which will be referred to as "R.B." The precise origin of the culture was unknown, but at one period it had been used in the manufacture of a prize-winning show cheese. When it was used in these experiments it had become rather weak in acid-producing power in the cheese-vat, and was being used as an example of a slow starter. It contained a variety of lactic streptococci, but no contaminating organisms so far as could be determined by examination under the microscope and growth in several media.

About 80 gallons of pasteurized milk of good bacteriological quality were divided into two equal portions which were run unto two vats. In one vat the slow starter R.B. was used, while in the other a normal starter served as a control. Both batches of milk were made into cheese. This procedure was repeated on seventeen occasions. The original idea of the experiment was to determine whether a slow starter gave better results when the proportion added to the vat was increased or when a normal amount was used and the ripening period extended. With this object in view variations in the procedure were made from day to day. The results from this aspect will be discussed in a later article. There were no abnormalities to be noted during the manufacture of the cheese beyond the above-mentioned lack of vitality of starter R.B.

The cheeses were examined when fourteen to twenty-one days old, and again when three to four months old. Some were retained in the

curing-rooms at the Massey Agricultural College experimental factory until mature, and some were shipped to London under normal conditions of transport. There were considerable variations in texture, body, and flavour, as was to be expected; but apart from these an almost constant feature of the cheeses made with the use of starter R.B. was a marked bitterness, which was present a fortnight after manufacture (the first occasion on which an examination was made), and which persisted throughout the entire period of observation. This was true even in those experiments in which by the use of large amounts of culture, or by a prolonged ripening period, starter R.B. had been induced to yield the same acidity in the whey as occurred in the control vat at the time of salting.

A review of the remarks of the graders on the cheeses revealed the fact that in eleven out of the seventeen occasions a marked bitterness distinguished the R.B. cheese from the controls. Possibly it was present to a lesser extent on some of the other six occasions, although it was not specifically mentioned. The bitterness was much more pronounced than that which may develop in normal cheeses, and did not disappear as the cheese ripened. In the fourteen-day grading, cheeses made with the use of starter R.B. were awarded on the average two points less than the controls in the figure for flavour, mainly on account of the bitterness. The remarks which had been noted daily on the starter cultures at the time of addition to the vat were reviewed, and it was found that on many occasions starter R.B. had shown a metallic or bitter flavour. Metallic flavours are, however, commonly detected in starters of low acidity, and are not necessarily correlated with bitter flavour in the cheese.

It was at first considered possible that lack of vitality in starter R.B. might have led to a somewhat abnormal series of events in the process of ripening, but this explanation was discounted when in a further series of comparisons between a normal starter and another slow starter no bitterness was detected in the cheese.

Several streptococci were isolated from starter R.B., and are still being examined in an investigation on the bacteriological aspects of cheese-ripening. A more complete knowledge of the biochemical characteristics of the several organisms may therefore throw more light on the mechanism of the production of the bitter flavour. There appear to be no strains in starter R.B. which will cause liquefaction of gelatine, so that abnormal proteolytic power of that type can be ruled out in a consideration of explanations of the phenomenon. It appears to be definitely established, however, that the mixture of streptococci in starter R.B. was capable of producing a bitter flavour in cheese, although it may be stated from general experience that not all "slow" starters nor all starters having a metallic flavour will produce bitterness in the cheese.

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PINK-ROT OF WOOL.

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IN this *Journal* for April last, under the title of "Two Occasional Defects in Wool," a record was made of a weak or rotten condition of wool sometimes met with in the fleeces of living sheep. As the subject proved one of some interest in certain quarters it has since been followed up at the Massey Agricultural College as opportunity offered, and the progress of the investigation is here set out.

Of the wool samples received for examination from various localities an appreciable number showed pink-rot in various stages, the condition appearing in both Romney and Merino wool. A report received that last season one particular clip had yielded three bales of affected wool is worthy of note.

The pinkness often accompanying the condition is one of the most striking features of pink-rot, but this tint may be mingled with light yellow or other light shades, or may be very pale or even entirely absent. The contraction or flattening of the wool locks in bands at affected levels, and the matting or clogging together of fibres in masses in such places, as if by some foreign substance, are other prominent features of pink-rot. This character is well shown in the accompanying photograph at the points marked, but, although a very common character, it may not be pronounced in the early stages.

The rottenness of the fibres is the worst feature of advanced pink-rot. In the early stages, however, the fibres are merely weak, and microscopic examination may be necessary for a satisfactory determination.

CAUSE OF PINK-ROT.

Pink-rot has been shown to arise as the result of bacterial activity. A bacterium has been isolated from pink-rotted wool and pure cultures of it repeatedly applied to good sound locks of Romney and other wool.

The wool was placed in covered glass dishes and the bacterium added, together with a little liquid food material in which it could multiply, the whole being incubated at 30° centigrade. The results of such experiments have been uniformly successful. In four days the wool shows microscopic signs of rotting (or "retting"); it becomes opaque, indicating the penetration into the fibres of bacterial products. In ten days the fibres become dull and chalky in appearance, with little or no strength left. When handled wet the fibres fall into masses of the cells of which they are composed. On drying this material clogs together in a manner characteristic of dried pink-rot found on the living sheep. The organism may readily be recovered from such material. If, moreover, the wool and food materials are incubated without the addition of the bacterium, then the wool develops no signs of the pink-rot condition.

It has therefore been clearly demonstrated that pink-rot can be produced by this bacterium. There are indications, however, that this is not the only bacterium that can disintegrate wool, and it is unlikely that any bacterium can do so except under certain extreme

conditions. On the other hand, it is probable that organisms capable of disintegrating wool are fairly common in the fleeces of sheep, and that, granted the requisite conditions, they are liable to become active and produce their effects.

Pink-rot does not typically affect the tips of locks, although it is sometimes found in that position. It is therefore not to be

LOCKS OF ROMNEY WOOL SHOWING AT THE POINTS MARKED THE CLOGGED OR MATTED CONDITION CHARACTERISTIC OF ADVANCED PINK-ROT.

[*Photo by H. Drake.*

confused with the pinkish condition sometimes occurring at the tips. The conditions favouring the development of bacteria in the fleece occur most commonly at or near the skin, although subsequent growth may carry the damaged zone outward. The temperature at the skin is only slightly greater than the optimum temperature for the growth of the isolated causative organism. If, therefore, under unusual circumstances, water should penetrate to the skin and the wool

there remain wet for a week or more, then it appears that if the organism is present pink-rot is liable to commence. It was noted, for instance, that some of the sheep that had been covered for certain experimental purposes were, in usually long spells of continuous wet weather, affected by pink-rot at the points where the bands securing the covers held the wet fleeces of the exposed sides and bellies close to the skin. These waterproof covers served in some cases to conduct rainwater to the sides, and the bands would hinder the drying-out of the fleece and hold it close to the warm skin, thus providing conditions favouring bacterial activity.

Pink-rot was also met with in cases where the fleece on the back had failed to keep out the weather. In some instances, however, the wool on the back itself, though badly weathered, was unaffected, but the rot was to be found down the sides near the skin in tracks where the water had drained through the fleece and there persisted for a greater length of time.

The Causative Organism.

Turning now to the more technical side of this subject, there are two matters concerning which records should be made :—

(1) The isolated causative organism promises to be a very convenient agent to employ in the study of the cellular structure and composition of the wool fibre. The organism appears to have little or no disintegrating effect upon the cells themselves, but rather to dissolve or soften some substance that normally holds the cells very firmly together. Advantage is therefore being taken of this in a study of the wool of our different breeds and of the structure of different fibre types. Moreover, "retted" wool is being sent abroad to ascertain its value in the study of the molecular structure of wool. The fact that wool can thus be reduced to such a finely divided condition by bacterial agency naturally suggests the possibility of utilizing this principle for some industrial purpose. This, however, is an unexplored field, although it has been ascertained that disintegrated wool may be reunited by moderate pressure and heat and made up, for example, into thin sheets of strong material.

(2) The isolated organism is a spore-bearing, gram positive, peritrichous rod capable of decomposing certain protein substances, and therefore belongs to the family Bacillaceae.* It is decidedly aerobic, and is saprophytic and gelatin liquefying; it forms rhizoid colonies, but does not greatly change its form at sporulation. Hence it falls in the genus Bacillus. It is definitely mesophilic and motile, and its spores are central to eccentric. It is deemed to fall among those "not *distinctly* swollen at sporulation," exhibits a white or cream-white pigment on nutrient gelatin, nutrient agar and potato, appears to be a very feeble liquefier of blood serum and to lack the brownish colour on potato. This suggests *vulgatus* as the species with which it coincides, and it will be seen that the two have many characters in common. Its optimum temperature is 30° centigrade; it produces acid in dextrose and sucrose, does not reduce nitrates, forms no indol, and corresponds with *vulgatus* fairly closely in its potato, broth, agar slope, and gelatin stab characters. However,

* Bergey's Manual of Determinative Bacteriology.

it softly coagulates milk before peptonizing it, and the short descriptions of the gelatin and agar colonies of *B. vulgatus* do not adequately cover the characters of the organism in question. The suggestion, therefore, that the organism is a variety of the species *vulgatus* must be received tentatively. Type cultures are being secured for comparison in various respects not mentioned above, including those relating to the action of the two organisms upon wool.

BIENNIAL BEARING IN APPLE TREES.

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BIENNIAL bearing is a problem which affects not only the New Zealand fruitgrower, but is experienced in all countries where fruit is grown. It is not only confined to apples, practically all fruits being subject in some degree to this habit of bearing a heavy crop in one season and a light crop in the following. In this article, however, it is proposed to deal only with the problem as it affects apples. Although the question is receiving world-wide attention, and considerable thought is being given to it by many research workers, no definite remedy applicable to all countries has been secured. However, valuable observations have been recorded from time to time, and many points have emerged which may be of assistance to the orchardist in studying the question.

The problem is inclined to slip past the notice of the majority with nothing more than a passing thought being paid to it. It is not because the grower does not consider it important or realize its seriousness, but often because he has come to regard this biennial bearing habit as pure "contrariness" on the part of the tree and quite beyond his control. That this habit can be gradually corrected is the opinion of most of the leading research workers who have studied the question, and many experiments are being carried out in different countries with this end in view.

The disadvantages suffered by the grower as a result of this "on-and-off" habit of bearing may be briefly summed up as follows:—

(1) The heavy crops carried in the "on" year causing an oversupply and dislocating the markets, with consequent difficulty in selling and resultant low prices.

(2) Loss in economic handling, due to equipment and organizations which are required to handle the crops in the years of heavy bearing being run under capacity in the years of short crops.

(3) Difficulty in stabilizing markets, both local and export, due to fluctuating quantities received each year.

(4) Difficulty in arranging for adequate supplies for packing and the necessary shipping and cool-storage space, due again to fluctuating quantities.

The advantages which would accrue could a uniform average crop be secured each year can be very well imagined. The whole work of the harvesting and marketing of the crop would then be made very much simpler and cheaper, and a much more stable average price should be obtained.

Biennial bearing must not be confused with the case of the irregularly cropping tree. Irregular cropping is often caused by poor nutrition, through a lack of sufficient manures, &c.; or following a year of heavy crops together with drought conditions; or, again, through unfavourable weather conditions at the time of setting. This is only temporary, as exceptionally short crops may only occur at long intervals. Irregular croppers, however, may at times become biennial bearers, through some agency which seriously disorganizes the internal processes of the tree. Further, must be kept separate the case of the unfruitful type of tree, caused by faulty pollination and lack of sufficient suitable varieties in close proximity to carry out cross-pollination. The true biennial bearer regularly crops heavily only every second year, the intervening years being marked by short crops.

It would appear that certain varieties are by nature more or less biennial bearers and are very easily thrown into such a state. Others, again, are thrown into this state by severe unfavourable conditions, which seriously disorganize the internal workings of the tree in any one year. In New Zealand probably the variety Dunn's Favourite is the most outstanding example of the naturally inclined biennial bearer; while Dougherty, Cox's Orange, and Ballarat are easily thrown into this bad habit. It is usually noticeable that spur-bearers are more easily upset and thrown into biennial bearing than those varieties which are lateral bearers.

While the tree may be thrown into a state of biennial bearing through unfavourable circumstances in one season, the process of restoring it to its natural bearing state cannot be accomplished at once or in one season. It would appear to be a gradual process, which cannot be unduly hurried by the adoption of drastic measures. More likely the adoption of such measures would lead to further disorders in the functions of the tree.

The cycle of biennial bearing is usually due to the fact that in the heavy year, owing to the demands made by the growing crop, there is little surplus food available for blossom-bud development, and consequently there is but a small blossoming the next season. Conversely, during the light year there is but a small growing crop, and there is a large surplus of food available for blossom-bud development, with a resultant heavy blossoming the following season; and so the cycle continues.

Practically all orchardists will be well aware of the fact that the blossom which appears in the spring was determined in the previous season; that is to say, the blossom-buds—from which the blossom developed—were formed during the previous season. Research workers have determined that the young growing bud commences to develop into a leaf-bud or a blossom-bud in late spring or early summer—as early as November in this country. It is considered that the determining factor in deciding in which direction a bud develops is the balance between the carbohydrates and nitrogen compounds at that time. Prominent workers consider that where the balance is in favour of carbohydrates blossom-bud development is favoured. On the other hand, if the balance is in favour of nitrogen, then leaf-bud formation will predominate.

In the years of light crops there is an abundance of leafage in the spring; far more leaf area is available than is required for elaborating

food for the setting and growing of the crop. Carbohydrates, which are manufactured by the leaves, are produced profusely, with the result that a large proportion of the young buds become blossom-buds. Thus in the following year there are heavy blossomings and settings.

In the years of heavy crops there is abundant blossom in the spring, but very little leafage. It has been calculated that in the heavy years there may be up to 50 per cent. less leafage than in the light years. With this great shortage in the leaf area practically all carbohydrates elaborated are absorbed by the setting and growing of the fruit. There is then practically no surplus available for blossom-bud formation, and so in the following spring a sparse blooming is experienced.

The whole question appears to be largely governed by leaf area, and attention should be focused on the matter of securing more uniform leafage each year. The first step must be to secure in the heavy year sufficient leaves in the early part of the season to provide an excess of carbohydrates above the amount required for setting and growing the crop, so that normal blossom-bud development may take place. The importance lies in securing the leafage early. If, as already stated, the destiny of the young bud is determined during or about November, the importance of sufficient early leafage can readily be seen, as if the required amount of leafage is not secured until December or later it is of little use.

A review of the methods which have been tried in the attempt to overcome the biennial bearing habit lead one to suggest pruning and manuring as being the most likely ones from which to secure beneficial results. Blossom-thinning has been tried with very satisfactory results in most cases. This is carried out in the heavy year when the blossoms open, and a drastic reduction is made in the number of blossoms. While this has proved satisfactory from the point of view of results, it is open to the objection of cost. Considerable time and labour have to be expended if the work is to be done thoroughly, and for that reason it is not intended here to include it as a suitable means of relief. It may be practised, however, to a limited degree in conjunction with pruning and manuring.

No advantage can be secured from thinning the fruit in the heavy year, so far as blossom-bud development is concerned. As the determining factor of the bud occurs during November, thinning the fruit is of no assistance unless completed at the beginning of November. Thinning the fruit is, of course, advantageous to the remaining fruits, and for the later storing of carbohydrates in the tree; it is, however, too late to be of material benefit for blossom-bud development.

Pruning must be carried out in conjunction with manuring to secure the best results. Pruning to secure relief from biennial bearing has two aims: one is to secure greater leaf-growth in the spring of the heavy year, and the other is to restrict blossoming in the same year.

It has already been mentioned that spur-bearers more readily become biennial croppers, and it is certainly more difficult to keep them in uniform bearing than the lateral-bearing type. Wherever possible, lateral growth should be encouraged on spur-bearers. The trees should be heavily spur-pruned the winter prior to the heavy

year, and all old clusters of spurs severely reduced and thinned out. This not only greatly reduces the blossom in the heavy year, but assists in producing lateral growth as well. The following winter those laterals which have formed should be cut back to induce further lateral growth during the ensuing light season. The next winter—that is, preceding the heavy year—these laterals should be left uncut, so as to form blossom-buds, which will bloom during the following light year.

With lateral bearers old weak laterals should be removed each year, and new laterals encouraged, which should be shortened in the winter preceding the light year, and left uncut in the winter preceding the heavy year. In the winter preceding the heavy year blossom-spurs should be well thinned out to reduce the amount of blossom.

Broadly speaking, the idea is to promote extensive lateral growth during the first light year, which growth is then left uncut, so that blossom-buds may be formed on the laterals during the heavy year for blossoming the following light year. Preceding the first heavy year the spurs should be well thinned, and the blossom heavily restricted, so that blossom-buds may be formed on the uncut laterals.

By leaving the laterals uncut preceding the heavy year they produce the leafage which is required during the early spring of the heavy year to elaborate carbohydrates for blossom-bud development.

Any manuring carried out should be an adjunct to pruning. The application of a nitrogenous fertilizer, such as sulphate of ammonia, in the early spring of the light year is recommended as an aid to the setting of the fruits. A further dressing of sulphate of ammonia is recommended to be given during blossoming, so that leaf-growth will be favoured by swinging the carbohydrate-nitrogen balance in favour of nitrogen, which favours leaf-bud and not blossom-bud formation at the critical period during November. During the spring of the heavy year no nitrogenous manures should be given, thus retarding setting and also tending to leave the carbohydrate-nitrogen balance in favour of carbohydrates, thus aiding blossom-bud formation. Although only nitrogenous fertilizers have been mentioned, it must be understood that normal applications of phosphates and potash should always be given.

It must be realized that results cannot be secured in one season, although in the third or fourth season it is reasonable to expect to observe an improvement. Normal pruning and manuring can then be gradually resorted to as the trees revert to regular normal annual bearing.

PACKING PASSION-FRUIT FOR MARKET.

INQUIRIES have been received as to the best method of packing passion-fruit for the market. Various-sized fruit-cases are sometimes used, but by far the most popular and suitable is one measuring 15½ in. by 12 in. by 4½ in. inside measurement. In this case the fruit packs snugly as a three-tier pocket pack, carrying about twelve dozen fruit, and weighing about 12 lb. As regards the stage of maturity for packing, the fruit should be ripe, but without any appearance of shrivelling.—*Horticulture Division.*

CORTICIUM DISEASE OF POTATOES.

III. LABORATORY AND FIELD METHODS FOR TESTING THE EFFICIENCY OF SEED TREATMENTS.

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POTATO plants may become infected with corticium disease either from sclerotia on the parent sets or from the fungus in the soil. Since in many cases the fungus may not be present in the soil, and most lines contain a high percentage of tubers carrying corticium sclerotia, control measures have been practically confined to seed-treatment.

Seed-treatment for corticium has been recommended ever since it was recognized that the disease was liable to cause a reduction in the yield of potato crops. The two treatments first to come into general use were one to two hour soaks in solutions of corrosive sublimate or of formalin. The strengths of solutions usually used were 1 part corrosive sublimate to 1,000 parts water, or 1 part formalin to 240 parts water. The long soak in cold formalin proved to be unsatisfactory in controlling corticium, and a short two to five minute dip in 1–120 formalin solution at about 125° F. was devised, and gradually took the place of the old method. A short dip in hot corrosive sublimate has been tested, but has not come into general use.

Up to the year 1925 the two treatments still in use were the cold corrosive sublimate soak and the hot formalin dip, but during that year two new treatments were recommended. The first was the use of organic mercury compounds which were recommended in both Germany and the United States, and the second was the acidulated corrosive sublimate treatment. Manufacturers have since then produced a large number of organic mercury compounds, but they have not yet successfully displaced the old corrosive sublimate or formalin methods.

LABORATORY METHODS.

In testing new treatments it is not always convenient to wait until field trials are carried out before the value of the treatments in controlling corticium can be known. Hence it is usual to test new treatments in the laboratory. The tubers bearing the sclerotia are treated, allowed to dry, and then the sclerotia are removed by means of a sterile scalpel. The sclerotia are thoroughly washed in sterile water and then transferred to petri dishes of potato dextrose agar, which are placed in an incubator at 21° C. Some of the sclerotia usually begin to germinate by the end of the second day, and all those not killed by the treatment are growing by the fifth day. If the petri dishes are kept for a week, one may be quite sure that growth is complete. By using this method of testing, the results of the efficiency of a treatment are obtained within a week. Thus a preliminary series is readily carried out, and subsequent series may be planned from the results obtained.

CORROSIVE SUBLIMATE TREATMENTS.

The efficiency of the old standard corrosive sublimate treatment which was generally employed by the earlier research workers in dealing with the corticium problem has been tested a number of times in the laboratory. There is, however, no consistent agreement in the results obtained, as may be seen from Table 1.

Table 1.

Name of Worker.	Year.	Strength of Corrosive Sublimate.	Length of Dip in Minutes.	Number of Sclerotia plated.	Percentage of Sclerotia which grew.
Gloyer	1913	1–1,000	90	100	0
Melhus and Gilman	1921	1–1,000	90	200	10·5
Thurston ..	1921	1–1,000	5	60	0
Thurston ..	1921	1–1,000	30	130	0
Thurston ..	1921	1–1,000	120	100	0
Cunningham ..	1925	1–1,000	90	15	6·7
White	1928	1–1,000	120	2,525	5·0
Chamberlain ..	1931	1–1,000	90	30	6·7
Chamberlain ..	1931	1–1,000	120	30	3·3

It is possible that some workers in making their 1–1,000 corrosive sublimate solution for treatment may have used the ordinary concentrated laboratory solution, which is made up with hydrochloric acid. This would lead to increased efficiency of treatment, and might explain the discrepancies in the results.

ACIDULATED CORROSIVE SUBLIMATE TREATMENTS.

The acidulated corrosive sublimate treatment for the control of corticium was devised by Cunningham (1925). As a result of an extensive series of experiments he recommended two treatments: (1) Overnight treatment—a sixteen-hour soak in a solution of 1–10–10,000* acidulated corrosive sublimate; (2) five-minute treatment—a five-minute dip in a solution of 1–10–1,500 acidulated corrosive sublimate.

Both these treatments gave complete control according to laboratory tests. The failure of these methods to give control in the field trials led to the publication of a further article by Cunningham and Neill (1926). In this article farmers were advised not to use the acidulated corrosive sublimate treatment until further work had been done on that method. Although no further publications have been made since then, the experiments were continued, and as a result this Laboratory has been recommending a one-hour-and-a-half soak in a 1–6·6–1,000 solution of acidulated corrosive sublimate. The idea of adding acid to corrosive sublimate solutions has been taken up by several American research workers, and Leach, Johnson, and Parson (1929) found that a five-minute dip in a 1–5–500 acidulated corrosive sublimate solution was more effective in controlling corticium than the standard 1–1,000 corrosive sublimate two-hour soak.

* 1–10–10,000 signifies 1 part corrosive sublimate, 10 parts hydrochloric acid, and 10,000 parts water.

TREATMENTS EXTENDING OVER TWO YEARS AT THE PLANT RESEARCH STATION.

During the winter of 1929 an attempt was made to evolve an improved method for corticium control. Since such promising results had been obtained by Cunningham's initial experiments with acidulated corrosive sublimate, this method was the first to be studied. The addition of hydrochloric acid to a solution of corrosive sublimate definitely increases the fungicidal properties of the solution, and a theoretical consideration of the problem suggested that the increased toxicity might be due to the ionization of the corrosive sublimate. If this were so, then the addition of an equivalent amount of a chloride to the solution should bring about the same result. In order to test this theory a series of treatments was planned, and the scheme of the experiment and the results may be seen in the following table :—

Table 2.

Solution.	Length of Soak in Minutes.							Control.
	15.	30.	45.	60.	75.	90.	120.	
1-1,000 corrosive sublimate ..	46·7	43·3	26·7	10	10	6·7	3·3	..
1–6·6–1,000 acidulated corrosive sublimate	0	0	0	0	6·7	0	3·3	86·7
1–3·4–1,000 corrosive sublimate plus sodium chloride	33·3	33·3	3·3	10	16·7	16·7	6·7	..

The figures given in the table represent the percentage of sclerotia which grew. There were thirty sclerotia plated in each treatment and sixty in the control.

The amounts of acid and salt added to the corrosive sublimate solutions in this experiment were such as to bring about ionization to the same extent. The results show that the addition of salt makes little or no difference to the fungicidal properties of the solution, so that it is clear that ionization is not responsible for the increased toxicity. This being the case, it seems probable that the addition of hydrochloric acid might bring about an increased penetration by some physical means. In an attempt to bring about a still greater penetration of the sclerotia an experiment was set out in which varying amounts of alcohol were added to acidulated corrosive sublimate solutions. The object of adding alcohol was to lower the viscosity of the solution.

In order to produce only partial killing of the sclerotia a 1–10–4,000 acidulated corrosive sublimate solution was used, and to portions of this were added 0, 2, 4, and 8 per cent. of alcohol respectively. A thirty-minute and a ninety-minute dip were employed, and twenty-five sclerotia from each treatment were cultured on potato dextrose agar. The alcohol had no noticeable influence on the toxicity of the acidulated corrosive sublimate solution, so it was concluded that the alcohol did not bring about any increased penetration.

In testing three organic mercury disinfectants—Semesan Bel, No. 664, and Cal-K made by the E. I. du Pont de Nemours and Co.—Cal-K proved to be the best fungicide. Cal-K is recommended for use

as an instantaneous dip, but a series of experiments were carried out in which both short-time dips and pre-soaks were included, the results being as follows :—

Table 3.

Solution.	Time Length of Dip.	Cold Water Pre-soak.	Number of Sclerotia plated.	Percentage of Sclerotia which grew.
Control ..	..	..	50	92
Cal–K. 1–40 ..	Instantaneous	..	50	70
Cal–K. 1–40 ..	5 minutes	..	50	0
Cal–K. 1–40 ..	10 minutes	..	50	0
Cal–K. 1–40 ..	Instantaneous	3 days	50	66
Cal–K. 1–40 ..	Instantaneous	6 days	50	62

The pre-soak in this instance consisted of dipping the tubers in cold water and then covering with a wet sack which was kept wet throughout the experiment. The results show that the pre-soak was of little value. Although the five- and ten-minute dips looked promising, it was discovered that when the five-minute treatment was used in the field it was too severe on the tubers. Thus in an experiment where one hundred control and one hundred treated tubers were planted the germination results at the end of thirty-two days were : Control, 96 per cent. growing ; treated, 27 per cent. growing.

Control of Corticium in the Field.

In the 1929–30 season a series of corticium control trials was carried out, using three different organic mercury disinfectants and the standard acidulated corrosive sublimate treatment. These treatments were tested in the laboratory, and both laboratory and field results are given in the following table :—

Table 4.

Treatment.	Strength of Solution.	Time Length of Dip.	Laboratory Results.		Field Results.	
			Number of Sclerotia.	Percentage which grew.	Number of Sets.	Percentage infected.
Control ..	..	..	50	48	125	70
Acidulated corrosive sublimate	1–6·6–1,000	1½ hours	50	0	300	11
Cal–K ..	1–40	Instantaneous	50	12	100	25
No. 664 ..	1–68	1 minute	50	38	100	34
Semesan Bel	1–10	Instantaneous	50	32	100	71

Several workers, as for example Schander and Richter (1924) and Cunningham and Neill (1926), noticed that although a treatment gave complete control according to laboratory methods it did not do so when tested in the field. The same difficulties have been met with in the present experiments. Out of 180 sclerotia taken from the tubers which have been treated by the standard method—1–6·6–1,000 acidulated corrosive sublimate one-hour-and-a-half soak and plated on to

potato dextrose agar—not one has grown. The results of the 1929–30 trials in Table 4 show that in the field this treatment gave 11 per cent. of infection.

A series of experiments was planned for the 1930–31 season to test further treatments for control of corticium and to gain further information concerning discrepancies between laboratory and field control. Results are given in Table 5. No laboratory tests were made of these treatments.

Table 5.

Type of Set.	Percentage of Tuber Infection.	Treatment.	Strength of Solution.	Time Length of Dip.	Number of Sets planted.	Percentage of Infection.
Seed ..	0	Control ..	..	..	300	2·3
Seed ..	0	Acidulated corrosive sublimate	1–6·6–1,000	1½ hours	100	2
Seed ..	100	Control ..	..	..	100	73
Seed ..	100	Corrosive sublimate	1–1,000	2 hours	100	13
Seed ..	100	Acidulated corrosive sublimate	1–6·6–1,000	1½ hours	100	12
Seed ..	100	Ditto	1–10–500	5 minutes	100	12
Seed ..	100	,, ...	1–10–500	20 minutes	100	9
Seed ..	100	,, ...	1–10–500	1½ hours	100	5
Cut table	100	Control ..	..	..	200	52·5
Cut table	100	Acidulated corrosive sublimate	1–6·6–500	1 hour	100	10
Cut table	100	Ditto	1–6·6–600	1 hour	100	7
Cut table	100	,, ...	1–6·6–800	1½ hours	100	13
Cut table	100	,, ...	1–10–700	1 hour	100	7

Again treatment by the standard method failed to give a satisfactory control. There are three possible explanations as to why the treatment did not give complete control in the field.

(1) The soil may have been infected with the corticium fungus, in which case reinfection might have occurred. In the case of the 1930–31 trials, the plots were so arranged that each treatment should have equal chances of infection. Under these circumstances, if the 12 per cent. infection occurring in the standard treatment line were to be put down to soil contamination, it would be difficult to explain why both the treated and untreated picked clean seed should show only 2 per cent. and 2·3 per cent. infection respectively. Also the treatments which are stronger than the standard treatments show a better field control. It is therefore improbable that the 12 per cent. infection shown by the treatment in 1930–31 can be explained by soil contamination alone.

(2) The fungus may have spread from adjacent rows during cultivation. Corticium does spread from plant to plant within a row (Chamberlain, 1931) and it is probable that a certain amount of spread has taken place in this way. Although there is no available evidence on the subject it is possible that a small percentage of infection may take place between one row and another. The infection of both the treated and untreated picked corticium-free seed might possibly be explained by this means. This is partly borne out by the fact that

ninety tubers of the same treated picked seed sown on a different part of the farm, away from other potatoes and in soil which had not grown a previous crop of potatoes, showed no infection at harvesting. However, the higher percentage occurring in the standard treatment cannot be entirely due to this cause.

(3) Some of the sclerotia, none of which grew on potato dextrose agar in the laboratory, may have grown under the conditions existing in the soil. This is possible, since neither soil infection nor spread of the fungus from adjacent rows adequately explains the degree of field infection occurring in potatoes treated by the standard method.

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INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 19th November to 17th December, 1931, include the following of agricultural interest:—

No. 65501: Hay-sweep; W. H. Franks. No. 65564: Fibre-treatment; J. van Boss. No. 66379: Fleece-deburring machine; R. Vicars. No. 67441: Farm roller; S. R. Duxfield. No. 67777: Grab for hay-stacker; D. McL. Wallace, Ltd. No. 67792: Fibres from plant-stalks; G. A. Lowry. No. 67813: Harrow; S. Doxey. No. 65594: Cover for stacks; W. Hutchinson. No. 65939: Knapsack sprayer; A. E. Grigg. No. 66058: Chicken-brooder; H. F. Rose. No. 66219: Teat-cup; W. McEwen. No. 66335: Protector and wire supports for fruit-trees; M. Davey. No. 66649: Cheese-press hoop; G. L. Noble and J. Simmons. No. 67839: Treating hard vegetable fibrous material; R. D. Coghill. No. 65689: Potato-sower; W. H. Barber. No. 65724: Cheese-vat; R. W. Currin. No. 65761: Administering pills to animals. No. 66031: Drenching horn; C. W. Pierson. No. 66207: Hay-sweep; W. D. Ross. No. 66359: Milking-machine; J. G. Henderson. No. 66362: Milking-machine; J. S. Read. No. 66537: Manure-distributor; J. Macalister. No. 67493: Phosphatic fertilizer; Oberphos Company. No. 67908: Hay-grab; H. V. Henrikson.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

POTATO-MANURING EXPERIMENTS IN THE SOUTH ISLAND.

SUMMARY OF EFFECTS OF MANURES OVER SIX SEASONS, 1925–26 TO 1930–31.

Fields Division, Department of Agriculture.

THE salient features of the results of sixty-seven experiments which have been carried out by the Fields Division during the past six seasons are here presented, and the effects on yield of superphosphate, sulphate of potash, sulphate of ammonia, and two ammonium phosphates are analysed. A summary of the findings, together with recommendations to farmers based on the latter, was published in this *Journal* for September, 1931.*

An outline of the methods employed in conducting potato-manuring experiments was published in the *Journal* for July, 1926. The only modifications since that time have been in method of applying fertilizers and in the sizes of plots. Hand application in the row with the sets has proved most accurate and least laborious, and has been adopted generally.

In the 1930–31 season single-row plots were adopted instead of the three-row plots previously used. This enabled greater replication with a reduction in area for each experiment to be effected without loss of accuracy. Work conducted in 1930–31 indicated that the effect of fertilizer in one row on the yield of plants in the adjoining row was negligible—with one exception, which need not be discussed here. Consequently, it was considered that the reduction in the number of rows per plot was justified. Plots were replicated from six to twenty times in the various experiments. Statistical examination of results has been carried out by " Student's " method in most cases.

Up to and including the 1927–28 season experiments were confined to North, Mid-, and South Canterbury. In 1928–29 and subsequently they were extended to Marlborough (1928–29 only), South Otago, and Southland. A list of co-operating farmers, showing the locations of experiments, is appended to this article. The numbers allocated to the different experiments are shown opposite the names of the farmers who co-operated in each of the seasons 1925–26 to 1930–31 inclusive.

OBJECTS OF THE EXPERIMENTS.

The objects of the experiments were :—

(*a*) To determine the effect of superphosphate when used alone, at 3 cwt., 5 cwt., and 7 cwt. per acre. It was assumed that 3 cwt. per acre was a good paying quantity to use, under Canterbury conditions at least.

(*b*) To determine the effect of using sulphate of potash and sulphate of ammonia, singly and together, each at 1 cwt. per acre, as adjuncts to superphosphate at 3 cwt. per acre.

* The summary indicated that the results of fifty-six experiments conducted in 1927–28 to 1930–31 inclusive would be presented. Space does not permit of the publication of detailed results, however, and differences between treatments only are shown in the tables. The analyses of yield differences are made from sixty-seven experiments, not sixty-three as stated in the summary.

(*c*) A few experiments were conducted to determine how ammonium phosphates, such as Ammophos and Diammonphos, compared with a mixture of super and sulphate of ammonia containing the same quantities of phosphoric anhydride and nitrogen.

(*d*) The effect of using sulphur in addition to a complete phosphate-potash-nitrogen fertilizer was also investigated in three experiments.

Evaluation of Increases due to Manure.

The economic values of increases due to various fertilizers are discussed in the comments following Tables 1, 2, 3, and 4. The following "round figure" values are allocated to potatoes and fertilizers: Table potatoes, £3 per ton (in the ground); seed potatoes, £1 10s. per ton (in the ground); superphosphate, 5s. per cwt.; sulphate of potash, 15s. per cwt.; sulphate of ammonia, 12s. per cwt. The value for potatoes represents their approximate average market values (£4 10s. for table and £3 for seed tubers), less per-ton charges for digging, bagging, cartage, &c., estimated at about £1 10s. On account of fluctuations in market prices and marketing costs it is impossible to state a definite value for potatoes. The costs of landing fertilizers on the farm and applying them will also vary, so "round figure" costs ex store are taken.

Treatments used in Type A and Type B Experiments.

Type A.

(1) No manure.
(2) Superphosphate (44/46 per cent. tricalcic phosphate), 3 cwt. per acre.
(3) Superphosphate (44/46 per cent. tricalcic phosphate), 5 cwt. per acre.
(4) Superphosphate (44/46 per cent. tricalcic phosphate), 7 cwt. per acre.

Type B.

(1) No manure.
(2) Superphosphate (44/46 per cent.), 3 cwt. per acre.
(3) Super 3 cwt., plus sulphate of ammonia 1 cwt., per acre.
(4) Super 3 cwt., plus sulphate of ammonia 1 cwt., plus sulphate of potash 1 cwt., per acre.
(5) Super 3 cwt., plus sulphate of potash 1 cwt., per acre.

Analysis of Effects of Different Fertilizers.

The effects of the various fertilizers on yields are shown in Tables 1 to 5 as follows: Table 1—effect of 3 cwt. of superphosphate per acre; Table 2—effect of increasing super above 3 cwt. per acre; Table 3—effect of sulphate of ammonia; Table 4—effect of sulphate of potash.

comments on table 1 (next page).

Super 3 cwt.—Average increases due to super at 3 cwt. per acre (forty-four experiments): Table potatoes, 0·96 tons (19 cwt. approximately); seed potatoes, 0·25 tons (5 cwt.): total, 1·32 tons (1 ton 6½ cwt. approximately).

In some cases the increase in total yield is statistically significant, whereas an increase in the yield of table potatoes may not be significant, or *vice versa*. Taking the common-sense viewpoint that such differences are real ones, we have thirty-nine experiments out of forty-four in which super at 3 cwt. per acre has given dependable increases in yield. In four of the other five experiments where increases were not significant the same experiment was conducted in another season.

Table 1.—Showing Effect of 3 cwt. of Superphosphate.

Differences in tons per acre between super 3 cwt. and no manure in experiments during seasons 1925–26 to 1930–31. (Type A and B experiments.)

Unless preceded by a minus sign, the figures signify increases. Increases printed in heavy type are statistically significant. This applies in both cases to all tables in this article.

Experiment No. (see Appendix).	Table.	Seed.	Total.
1925–26 and 1926–27 Seasons.			
1 ..	**2·5**	**0·3**	**2·8**
2 ..	0·0	**0·4**	**0·5**
5 ..	**1·3**	0·1	**1·5**
6 ..	**1·5**	0·3	**1·8**
7 ..	**1·1**	−0·1	**1·3**
8 ..	**0·8**	**0·3**	**1·2**
11 ..	**1·8**	..	**1·8**
1927–28 Season.			
12 ..	**1·0**	**0·6**	**1·8**
13 ..	**0·2**	**0·4**	**0·7**
14 ..	−0·3	−0·2	−0·6
15 ..	**1·2**	0·0	**1·2**
1928–29 Season.			
16 ..	**1·2**	0·0	**1·2**
17 ..	**0·9**	**0·3**	**1·4**
18 ..	**0·6**	**1·3**	**2·1**
19 ..	**0·8**	**0·2**	**1·1**
20 ..	**1·0**	−0·1	**0·9**
21 ..	−0·1	0·2	0·1
35 ..	−0·1	0·0	−0·1
37 ..	0·0	−0·1	0·1
1929–30 Season.			
22 ..	**0·8**	**0·5**	**1·4**
23 ..	**0·9**	**0·5**	**1·8**
24 ..	**0·7**	**0·3**	**1·2**
1929–30 Season—continued.			
25 ..	**0·3**	0·0	0·3
26 ..	**1·1**	**0·4**	**1·8**
27 ..	**1·9**	**0·4**	**3·0**
38 ..	**1·8**	0·2	**2·2**
39 ..	**1·1**	0·1	**1·3**
40 ..	**0·7**	**0·2**	**0·9**
41 ..	**1·9**	**1·2**	**3·8**
42 ..	**1·5**	**0·7**	**2·4**
43 ..	**0·5**	**0·3**	**1·1**
44 ..	**1·8**	−0·5	**1·3**
45 ..	**0·9**	**0·5**	**1·6**
47 ..	**0·5**	**0·3**	**1·8**
48 ..	**0·4**	**0·4**	**1·0**
49 ..	0·2	0·0	0·2
1930–31 Season.			
50 ..	0·3	**0·3**	**0·6**
51 ..	**1·3**	**0·3**	**1·6**
52 ..	−0·1	**0·3**	**0·6**
53 ..	0·4	0·3	**0·7**
54 ..	**1·9**	**0·5**	**2·4**
55 ..	**1·3**	−0·3	0·0
56 ..	**2·5**	0·0	**2·8**
64 ..	**2·5**	0·1	**2·6**
Average of 44 trials	**0·96**	**0·25**	**1·32**

NOTE.—In this and the following table small potatoes are not shown, but are included in the totals; hence the total is not necessarily the sum of table and seed potatoes.

With one exception (Experiments 21 and 25, Voss, Willowbridge), one of the seasons gave a sufficient increase to more than pay for the manure used in both seasons.

Although comparatively poor results were obtained at Voss's Willowbridge, excellent returns resulted from the use of super at Smith's, Willowbridge (Nos. 11 and 15). At Carr's, Methven (No. 35), the trial which suffered very adverse conditions was not repeated. From the writer's knowledge of this district it can be confidently stated that the use of super with the potato crop will pay well.

It can be concluded, therefore, that at least forty-one out of the forty-four areas on which experiments were conducted showed a paying return from the use of super at 3 cwt. per acre.

At £3 per ton for table and £1 10s. for seed potatoes, and 5s. per cwt. for super, the general average monetary return is as follows:—

	£	s.	d.
Value of 19 cwt. table potatoes	2	17	0
Value of 5 cwt. seed potatoes	0	7	6
	3	4	6
Less cost of 3 cwt. of super	0	15	0
Profit per acre	2	9	6

The profit per acre of £2 9s. 6d. represents a 330-per-cent. return on the outlay for superphosphate. It is obvious that farmers cannot afford to neglect the use of super with the potato crop.

The average yields of forty-four experiments in which super 3 cwt. per acre was used were as follow, the figures representing tons per acre :—

	Table.	Seed.	Total.
No manure	4·45	1·95	7·35
Super 3 cwt.	5·41	2·20	8·67

The yields of the no-manure plots ranged from 1 ton to 13·2 tons of table potatoes. The lower-yielding crops were affected either by climatic conditions or disease.

Table 2.—Showing Effect of Increasing Super above 3 cwt. per Acre.

Differences between (*a*) super 5 cwt. and super 3 cwt., and (*b*) super 7 cwt. and super 5 cwt. in experiments during seasons 1925–26 to 1930–31. (Type A experiments.)

Experiment No. as in Appendix.	Increase of Super 5 cwt. over Super 3 cwt. in Tons per Acre.			Experiment No. as in Appendix.	Increase of Super 7 cwt. over Super 5 cwt. in Tons per Acre.		
	Table.	Seed.	Total.		Table.	Seed.	Total.
			1925–26 and 1926–27 Seasons.				
1 ..	**0·8**	0·0	**0·5**	1 ..	−0·1	0·1	0·1
2 ..	**0·5**	−0·1	**0·3**	2 ..	0·1	0·2	**0·3**
7 ..	0·4	**0·3**	**0·6**	7 ..	0·3	0·2	**1·0**
8 ..	0·0	**0·1**	0·2	8 ..	0·2	0·0	0·1
			1927–28 Season.				
12 ..	**0·3**	**0·9**	**1·4**	12 ..	**0·8**	0·0	**0·7**
13 ..	0·0	0·1	0·1	13 ..	0·2	−0·1	0·1
14 ..	**1·2**	0·1	**1·6**	14 ..	−0·9	0·1	−1·0
15 ..	−0·6	0·1	−0·4	15 ..	**1·2**	0·1	**1·3**
			1928–29 Season.				
17 ..	0·1	0·1	0·2	17 ..	0·0	0·2	0·2
18 ..	0·0	0·0	0·0	..	..	..	..
19 ..	0·1	−0·1	0·0	19 ..	0·1	0·1	0·2
20 ..	**0·7**	0·1	**1·1**	20 ..	−0·3	0·0	−0·5
21 ..	−0·2	0·0	0·0	21 ..	0·9	0·0	0·9
			1929–30 Season.				
22 ..	**0·8**	**0·2**	**0·9**	22 ..	−0·5	0·0	−0·5
23 ..	**0·6**	0·1	**0·8**	23 ..	0·2	0·2	0·5
24 ..	0·0	0·0	0·1	24 ..	0·1	**0·2**	**0·2**
25 ..	−0·1	−0·1	−0·2	25 ..	−0·1	0·0	−0·1
26 ..	0·1	0·1	0·4	26 ..	0·3	0·0	0·2
27 ..	−0·2	0·0	−0·1	27 ..	**0·5**	−0·1	**0·7**
Average of 19 trials	**0·24**	**0·1**	**0·39**	Average of 18 trials	**0·17**	**0·07**	**0·24**

COMMENTS ON TABLE 2.

Super 5 cwt. per Acre versus Super 3 cwt.—The general average increase of super 5 cwt. over super 3 cwt. is just under ¼ ton of table potatoes, which is sufficient to leave a profit of about 5s. per acre from the extra 2 cwt. of super reckoned on table potatoes alone. It is inadvisable to consider the effect of 5 cwt. of super on the general average, however. The increases fall into two fairly well-defined groups—namely (*a*) those experiments in which there is a significant and quite large increase (Nos. 1, 7, 12, 14, 20, 22, 23), and (*b*) those

in which the increase, if any, is very small and not paying (Nos. 2, 8, 13, 15, 17, 18, 19, 21, 24, 25, 26, 27). Experiment 2 is included in group (*b*) because Experiments 8 and 13 on the same farm in different seasons fall in group (*b*) and indicate that the heavier quantity of super is not profitable in the main on this farm.

The seven experiments in group (*a*) are all on rich alluvial soil, which is potentially and reputedly high-producing land. Although all of the experiments in this group did not give heavy yields, the poor crops can be attributed generally to unusually adverse weather conditions or to seed badly infected with virus diseases.

The average increases over no manure from 3 cwt. of super in experiments in group (*a*) are: Table 1 ton, seed 0·21 ton, per acre. These figures are in very close agreement with the general average increase for forty-four experiments shown in Table 5.

The average increases of 5 cwt. over 3 cwt. of super for group (*a*) are: Table 0·7 tons, seed 0·24 tons, per acre. This gives the following increases over no manure as a result of using 5 cwt. of super: Table 1·7 tons, seed 0·45 tons, per acre.

The result on the financial return shows a net profit from the use of 5 cwt. of super in the seven experiments in group (*a*) of about £4 10s. per acre.

The eleven experiments in group (*b*) show a considerable loss as a result of increasing the amount of super from 3 cwt. to 5 cwt. per acre. Most of these experiments were on light to medium class potato land, although three to four of them were on the richer soils represented by group (*a*).

The conclusion which must be drawn is that the use of super up to the rate of 5 cwt. per acre is, generally speaking, highly paying on the better-class potato soils, but the use of more than 3 cwt. per acre is not justified on the lighter to medium class soils.

Super 7 cwt. versus Super 5 cwt. per Acre.—Increasing the quantity of superphosphate to 7 cwt. per acre has caused a general average increase (eighteen trials), which just about meets the cost of the extra super. The individual results are very inconsistent, however. In two experiments the yields have been significantly depressed below those from 5 cwt. of super. In three experiments the increases of table potatoes are large and significant, but in two of these an undue superiority is given to the effect of super 7 cwt. compared with super 5 cwt., as the actual effect of super 5 cwt. was less than that from super 3 cwt. The results indicate that *in the main* there is no justification for using more than 5 cwt. per acre of super even on the best potato soils.

COMMENTS ON TABLE 3.

Super 3 cwt., plus Sulphate of Ammonia 1 cwt. versus Super 3 cwt.—The addition of 1 cwt. of sulphate of ammonia to super at 3 cwt. has been tried in thirty-six experiments. The average increases—0·48 tons of table (9½ cwt. approximately) and 0·25 tons (5 cwt. approximately) of seed potatoes—are worth, on the values adopted, about £1 17s. This increase has been obtained from an outlay of 12s. on 1 cwt. of sulphate of ammonia, leaving a net profit of £1 5s. per acre, or approximately 200 per cent., on the outlay.

Table 3.—Showing Effect of Sulphate of Ammonia.

Differences between (*a*) super 3 cwt., plus sulphate of ammonia 1 cwt., and super 3 cwt.; (*b*) super 3 cwt., plus sulphate of ammonia 1 cwt., plus sulphate of potash 1 cwt., and super 3 cwt., plus sulphate of potash 1 cwt.

Experiment No. as in Appendix.	Increase of Super 3 cwt., plus Sulphate of Ammonia 1 cwt., over Super 3 cwt., in Tons per Acre.			Experiment No. as in Appendix.	Increase of Super 3 cwt., plus Sulphate of Ammonia 1 cwt., plus Sulphate of Potash 1 cwt., over Super 3 cwt., plus Potash, in Tons per Acre.		
	Table.	Seed.	Total.		Table.	Seed.	Total.
			1925–26 and 1926–27 Seasons.				
3 ..	1·8	0·3	2·1	3 ..	1·3	0·2	1·4
4 ..	0·3	0·5	0·9	..	..	..	..
6 ..	−0·1	0·4	0·5	..	..	..	..
9 ..	−0·7	0·4	−0·3	9 ..	−0·4	0·3	0·4
10 ..	0·0	0·1	0·2	..	..	..	..
			1927–28 Season.				
28 ..	−0·9	0·4	−0·3	28 ..	−0·6	0·1	−0·4
29 ..	0·4	0·4	0·8	29 ..	0·4	0·5	1·0
30 ..	0·6	0·1	0·9	30 ..	−0·2	−0·2	−0·2
31 ..	1·2	0·0	1·1	31 ..	0·1	−0·1	0·0
			1928–29 Season.				
32 ..	0·8	0·5	1·4	32 ..	1·5	0·1	1·6
33 ..	0·4	1·2	1·8	33 ..	0·9	1·4	2·5
34 ..	0·7	0·1	0·8	34 ..	0·3	0·1	0·5
35 ..	0·2	0·2	0·5	..	..	..	..
36 ..	0·8	0·2	1·1	36 ..	0·4	−0·1	0·4
37 ..	0·1	0·1	0·5	37 ..	−0·2	0·2	0·6
57 ..	1·0	0·0	1·1	57 ..	0·7	0·1	0·8
58 ..	0·3	0·3	0·4	58 ..	0·3	0·0	0·6
			1929–30 Season.				
38 ..	1·2	0·0	1·2	38 ..	0·7	0·1	1·0
39 ..	1·0	0·5	1·6	39 ..	0·6	0·5	1·3
40 ..	0·1	0·2	0·4	40 ..	0·7	0·3	1·1
41 ..	1·0	−0·3	0·4	41 ..	0·7	−0·3	0·3
42 ..	0·6	0·4	1·0	42 ..	1·2	0·1	1·2
43 ..	1·2	0·5	2·1	43 ..	1·5	0·3	2·1
44 ..	0·1	0·6	0·8	44 ..	0·6	0·4	1·2
45 ..	1·0	−0·1	1·4	45 ..	0·9	0·3	1·5
46 ..	0·7	0·3	1·2	46 ..	0·3	0·3	0·8
47 ..	0·2	0·1	0·6	47 ..	0·4	0·2	1·0
48 ..	0·2	0·1	0·4	48 ..	−0·1	−0·3	−0·5
49 ..	0·5	0·1	1·0	49 ..	0·0	0·0	−0·2
..	..	..	..	59* ..	0·1	0·1	0·2
..	..	..	..	60* ..	0·6	0·6	1·5
..	..	..	..	61* ..	−0·3	0·2	−0·1
..	..	..	..	62* ..	0·2	0·1	0·4
..	..	..	..	63* ..	1·1	0·1	1·5
			1930–31 Season.				
50 ..	0·2	0·2	0·4	50 ..	0·5	0·2	0·7
51 ..	0·3	−0·1	0·2	51 ..	0·1	−0·1	0·0
52 ..	−0·2	0·3	0·7	52 ..	0·0	0·3	1·1
53 ..	0·4	0·3	0·9	53 ..	0·4	0·3	0·9
54 ..	1·3	0·5	1·8	54 ..	0·8	0·2	1·0
55 ..	0·3	0·2	0·6	55 ..	1·0	0·4	1·7
56 ..	0·2	0·1	0·8	56 ..	0·6	0·1	1·1
..	..	..	..	64* ..	0·9	0·0	0·9
Average of 36 trials	0·48	0·25	0·87	Average of 38 trials	0·47	0·18	0·81

* 132 lb. sulphate of ammonia used.

Only eighteen experiments show statistically significant increases in the yields of table potatoes. In eleven other experiments significant increases in total yields are shown, though not significant in the case of table tubers. It is reasonable to assume, therefore, that at least twenty-nine of the thirty-six trials show significant increases due to

the use of nitrogen. In two cases (Experiments 39 and 52) yields of table potatoes are significantly reduced, although the yields of "seed" are increased.

Super 3 cwt., plus Sulphate of Potash 1 cwt., plus Sulphate of Ammonia 1 cwt. versus Super 3 cwt., plus Sulphate of Potash 1 cwt.—The general average result of using sulphate of ammonia as an addition to super plus sulphate of potash in thirty-eight trials is very similar to that just commented on. In some cases, notably in Experiments 33, 40, 42, 44, and 55, the effect of using sulphate of ammonia in addition to super plus potash is much better than where sulphate of ammonia is added to super only. In Experiments 3, 31, 36, 49, and 54 the reverse is very much in evidence.

In experiments 30, 31, 48, and 49 super plus sulphate of ammonia and super plus potash have both been superior to super alone, but the complete fertilizer—super plus potash plus sulphate of ammonia—is no better than super plus sulphate of ammonia or super plus potash. Possibly available moisture has limited the effect of the complete fertilizer.

Response to Sulphate of Ammonia as affected by Soil and Climatic Conditions.—Consideration of the response to sulphate of ammonia in relation to soil and climatic conditions leads to the conclusion that the effectiveness of sulphate of ammonia is governed more by climatic conditions than by soil conditions. Good and poor responses have occurred with more or less equal frequency on all classes of soil. Climatic conditions do, however, appear to have a marked influence on the crop response, especially in regard to table potatoes.

The use of sulphate of ammonia undoubtedly causes the formation of increased numbers of tubers. So long as the moisture supply is reasonable and well distributed over the growing season a normal percentage of tubers will grow to the table size, but if dry conditions are experienced, particularly during December and January, a smaller percentage of the tubers than usual attain the table size. This effect is so marked in a few cases as to cause an actual reduction in the yield of tables, though the yields of seed and small may be so increased as to cause a greater total yield from plots sown with sulphate of ammonia than where no sulphate of ammonia is used.

Since it is impossible to predict climatic conditions sufficiently far ahead, the obvious thing to do is to use sulphate of ammonia consistently, as the results here presented indicate that over the average of a number of seasons the returns will be paying.

COMMENTS ON TABLE 4.

Super 3 cwt., plus Sulphate of Potash 1 cwt. versus Super 3 cwt.—In spite of its reputation as a desirable fertilizer for the potato crop, potash has not been particularly effective in general. As its effectiveness appears to be governed principally by soil-type, it is not proposed to discuss the results from point of view of the general average.

The inconsistency of the effect of potash makes interpretation of results rather difficult. In Experiments 37, 42, 47, 54, and 58 it has proved effective and very profitable when used with super on the one hand, and with super plus sulphate of ammonia on the other. In Experiments 30, 31, 48, and 49 good and paying returns have resulted

when potash has been used with super, but when used with super plus sulphate of ammonia the yields have been practically no better than those from super plus potash or super plus sulphate of ammonia. In Experiments 33, 52, and 55 potash used with super gave poor to fair results, but gave better results when used with super plus sulphate of ammonia as a complete manure. In two experiments, 40 and 44, the use of potash caused the yields to be depressed.

Table 4.—Showing Effect of Potash.

Differences in tons per acre between (*a*) super 3 cwt., plus sulphate of potash 1 cwt., and super 3 cwt.; (*b*) super 3 cwt., plus sulphate of ammonia 1 cwt., plus sulphate of potash 1 cwt., and super 3 cwt., plus sulphate of ammonia.

Unless preceded by a minus sign, the figures signify increases. Increases printed in heavy type are statistically significant.

Experiment No. as in Appendix.	Increase of Super 3 cwt., plus Sulphate of Potash 1 cwt., over Super 3 cwt.			Experiment No. as in Appendix.	Increase of Super 3 cwt., plus Sulphate of Ammonia 1 cwt., plus Sulphate of Potash 1 cwt., over Super 3 cwt., plus Sulphate of Ammonia 1 cwt.		
	Table.	Seed.	Total.		Table.	Seed.	Total.
				1925–26 and 1926–27 Seasons.			
3 ..	0·4	0·1	0·5	3 ..	−0·2	−0·1	−0·2
..	..	..	..	4 ..	0·2	0·0	0·2
..	..	..	..	6 ..	0·0	−0·2	−0·2
9 ..	−0·2	−0·1	−0·2	9 ..	0·0	0·2	0·5
..	..	..	..	10 ..	0·1	0·0	0·1
				1927–28 Season.			
28 ..	−0·2	0·0	−0·2	28 ..	0·1	−0·3	−0·3
29 ..	0·1	0·0	0·0	29 ..	0·1	0·1	0·2
30 ..	**0·9**	0·2	**1·1**	30 ..	0·1	−0·1	0·0
31 ..	0·6	0·3	**0·9**	31 ..	−0·5	0·2	−0·2
				1928–29 Season.			
32 ..	−0·4	**0·2**	−0·2	32 ..	0·3	−0·2	0·0
33 ..	0·2	−0·2	−0·1	33 ..	**0·7**	0·0	**0·6**
34 ..	0·4	0·1	0·3	34 ..	0·0	0·1	0·0
..	..	..	..	35 ..	0·1	0·1	0·2
36 ..	−0·1	0·0	−0·1	36 ..	−0·5	−0·3	−0·8
37 ..	**1·8**	**1·1**	**3·0**	37 ..	**1·5**	**1·2**	**3·1**
57 ..	0·2	−0·1	0·2	57 ..	−0·1	0·0	−0·1
58 ..	**0·5**	0·2	**0·4**	58 ..	**0·5**	−0·1	**0·6**
				1929–30 Season.			
38 ..	0·7	−0·1	0·6	38 ..	0·2	0·0	0·4
39 ..	0·4	0·1	0·4	39 ..	0·0	0·1	0·1
40 ..	−0·4	−0·1	−0·5	40 ..	0·2	0·0	**0·2**
41 ..	**0·7**	−0·1	0·3	41 ..	0·4	−0·1	0·2
42 ..	**0·7**	0·1	**0·8**	42 ..	**1·3**	−0·2	**1·0**
43 ..	0·1	0·2	**0·4**	43 ..	**0·4**	0·0	**0·4**
44 ..	−0·9	0·2	−0·8	44 ..	−0·4	0·0	−0·4
45 ..	0·1	0·1	0·4	45 ..	0·0	0·5	0·5
46 ..	0·1	0·1	0·3	46 ..	−0·3	0·1	−0·1
47 ..	0·5	**0·4**	**1·1**	47 ..	**0·7**	**0·5**	**1·5**
48 ..	0·3	0·3	**0·8**	48 ..	0·0	0·1	**0·1**
49 ..	**0·6**	0·0	**0·9**	49 ..	**0·2**	−0·1	−0·3
				1930–31 Season.			
50 ..	−0·1	0·0	−0·1	50 ..	0·2	0·0	0·2
51 ..	**0·4**	−0·2	0·2	51 ..	0·2	−0·2	0·0
52 ..	**0·3**	0·0	0·1	52 ..	**0·5**	0·0	**0·5**
53 ..	**0·1**	−0·1	−0·1	53 ..	0·1	−0·1	−0·1
54 ..	**1·1**	**0·3**	**1·4**	54 ..	**0·6**	0·0	**0·6**
55 ..	−0·2	−0·1	−0·2	55 ..	**0·5**	0·1	**0·9**
56 ..	0·1	0·0	−0·0	56 ..	0·5	0·0	0·3
Average of 32 trials	**0·27**	**0·08**	**0·36**	Average of 36 trials	**0·21**	**0·04**	**0·27**

Districts represented by the following experiments are indicated as being responsive to potash with the potato crop to a paying extent :—

Experiments 33 and 42 : Westaway, Kirwee, Canterbury.
,, 43 and 52 : Crozier, Mitcham, Mid-Canterbury.
,, 30 and 58 : Westaway, Temuka, South Canterbury.
,, 31* : Smith, Willowbridge, South Canterbury.
,, 54 : Gibson, Taieri, South Otago.
,, 49 and 55 : Knibbs, McNab, Southland.
,, 37 and 47 : Experimental Farm, Gore, Southland.
,, 48 : Friend, Gore, Southland.

* It should be noted that potash was quite ineffective when used with super and sulphate of ammonia in this experiment, and that it was also ineffective in Experiments 36 and 46 at Voss's, Willowbridge. In other of the above experiments good results have been obtained when potash was used in conjunction with super, but very indifferent results occurred when potash was added to super and sulphate of ammonia and *vice versa*. The failure of the complete manure to give better results than super plus sulphate of ammonia or super plus potash cannot be attributed to either the potash or the sulphate of ammonia. As stated previously, it is possible that available moisture has limited the effect of the complete manure.

Type C Experiments.

The following treatments were used in the Type C experiments :—

(*a*) (1) Superphosphate 44/46, 3 cwt. per acre.
(2) Super 3 cwt., plus sulphate of ammonia 1 cwt., per acre.
(3) Ammophos, 169 lb. per acre.
(4) Super 3 cwt., plus sulphate of potash, 1 cwt., per acre.
(5) Super 3 cwt., plus sulphate of potash 1 cwt., plus sulphate of ammonia 1 cwt., per acre.

(*b*) (1) Super 3 cwt., plus sulphate of potash 1 cwt., per acre.
(2) Super 3 cwt., plus sulphate of ammonia 132 lb., plus sulphate of potash 1 cwt., per acre.
(3) *Ammophos 200 lb., plus sulphate of potash 1 cwt., per acre.
(4) Diammonphos 132 lb. plus sulphate of potash 1 cwt., per acre.

* Note.—Where the ammonium phosphate (Ammophos and Diammonphos) were used the quantities were adjusted so as to supply the same amounts of nitrogen and phosphate as were supplied by the super plus sulphate of ammonia mixture. The Ammophos was a mixture of two grades, one containing 10·7 per cent. of nitrogen and 48 per cent. of phosphoric anhydride, and the other containing 16·5 per cent. of nitrogen and 20 per cent. of phosphoric anhydride. Diammonphos contains 20·5 per cent. of nitrogen and 52·5 per cent. of phosphoric anhydride.

COMMENTS ON TABLE 5.

In two of the trials (Nos. 57 and 63) in Table 5, a mixture of super plus sulphate of ammonia has proved significantly better than Ammophos—in Experiment 57 by 0·7 tons table potatoes, and in Experiment 63 by 0·3 tons table and 0·3 tons seed potatoes.

In Experiments 62, 63, and 64 the mixture containing super plus sulphate of ammonia has proved significantly superior to that containing Diammonphos—in No. 62 by 0·9 tons, and in No. 64 by 0·3 tons of table potatoes. In No. 63 the difference in table potatoes is not significant, although the seed and total yields differ significantly.

Since neither Ammophos nor Diammonphos have proved superior to super plus sulphate of ammonia to a significant extent in any of the trials, but super plus sulphate of ammonia has in four out of eight

Table 5.—Comparison of Super 3 cwt., plus Sulphate of Ammonia 132 lb. (or 1 cwt.), with same Amount of Phosphate and Nitrogen in Form of (a) Ammophos and (b) Diammonphos.

Experiment No. as in Appendix.	Increases in Tons per Acre of Super plus Sulphate of Ammonia over Ammophos.			Experiment No. as in Appendix.	Increases in Tons per Acre of Super plus Sulphate of Ammonia over Diammonphos.		
	Table.	Seed.	Total.		Table.	Seed.	Total.
			1928–29 Season.				
57 ..	0·7	0·0	0·7	..	..	..	..
58 ..	0·4	0·2	0·2	..	..	..	..
			1929–30 Season.				
59* ..	0·0	0·0	0·0	59 ..	—0·1	0·0	0·0
60 ..	..	..	..	60 ..	0·0	0·2	0·2
61* ..	—0·6	—0·4	—1·0	61 ..	—0·1	0·0	—0·1
62* ..	0·1	0·1	0·2	62 ..	**0·9**	0·2	**1·3**
63* ..	**0·3**	**0·3**	**0·7**	63 ..	0·4	**0·2**	**0·7**
			1930–31 Season.				
64* ..	0·2	0·0	0·2	64 ..	**0·8**	—0·1	0·2
Average of 7 trials	**0·16**	**0·03**	**0·14**	Average of 6 trials	**0·23**	**0·08**	**0·38**

* Sulphate of potash at 1 cwt. per acre supplied to each of the three treatments mentioned.

trials proved superior to either Ammophos or Diammonphos, the logical conclusion is that the mixture of super plus sulphate of ammonia is in the main superior in effect to ammonium phosphates as represented by Ammophos and Diammonphos.

The effects of sulphate of ammonia and potash in these trials come under consideration with other trials in Tables 3 and 4.

Type D Experiments.

Treatments used in Type D experiments were as follow:—

(1) Super 3 cwt., plus sulphate of ammonia 1 cwt., plus sulphate of potash 1 cwt., per acre.
(2) Super 3 cwt., plus sulphate of ammonia 1 cwt., plus sulphate of potash 1 cwt., plus ground sulphur 3 cwt., per acre.

Table 6.—Comparison of Super 3 cwt., plus Sulphate of Ammonia 1 cwt., plus Sulphate of Potash 1 cwt., with same plus Ground Sulphur 3 cwt. (Type D Experiments.)

Experiment No. as in Text.	Season.	Increases in Tons per Acre of Mixture containing Sulphur over No Sulphur.		
		Table.	Seed.	Total.
65	1929–30	0·2	0·0	0·2
66	1929–30	**0·8**	**0·7**	**1·5**
67	1930–31	0·2	—0·1	0·1
Average of 3 trials ..	...	**0·4**	**0·2**	**0·6**

COMMENTS ON TABLE 6.

The use of sulphur has caused the yield to be increased to a significant extent in one experiment, No. 66. The value of the increase is about £3, and the cost of 3 cwt. of sulphur at the present price somewhat more than £3.

ACKNOWLEDGMENTS.

The assistance of those farmers who provided land and facilities for carrying out the foregoing experiments is gratefully acknowledged.

The following Fields Division officers were concerned with the carrying-out of the trial: Messrs. Elliott (Marlborough), A. Y. Montgomery and W. C. Stafford (Christchurch), E. M. Bates (Ashburton), R. A. Calder and K. M. Montgomery (Timaru), A. Hume (Dunedin), G. Wild and A. S. Duff (Invercargill), A. Stuart (Gore) and J. Sleeman, Gore Experimental Area.

APPENDIX.

Statement of Names and Locations of Co-operating Farmers and Numbers used to indicate Experiments in Tables 1, 2, 3, 4, and 5.

Name and Location.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	1930–31.
L. C. Banks, Coutts Island, Canterbury	1, 3	7, 9	..	..	..	..
W. and A. Campion, Prebbleton, Canterbury	2, 4	8, 10	13, 29	..	..	..
S. McIntosh, Kaiapoi, Canterbury ..	..	5	12, 28	..	..	..
H. McLenaghen, Killinchy, Canterbury	..	6	..	..	..	..
W. Smith, Willowbridge, Canterbury ..	..	11	15, 31	..	..	..
W. Westaway, Temuka, Canterbury ..	..	..	14, 30	20, 58	..	..
J. McMullen, Kaiapoi, Canterbury ..	..	..	..	16, 57	23, 59	..
A. K. Case, Prebbleton, Canterbury ..	..	..	..	17, 32	39	..
F. Westaway, Kirwee, Canterbury ..	..	..	..	18, 33	42	..
J. C. Lockhead, Rokeby, Canterbury ..	..	..	..	19, 34	..	..
H. Voss, Willowbridge, Canterbury ..	..	..	..	21, 36	25, 46	..
J. Carr, Methven, Canterbury ..	..	..	..	35	..	..
Experimental Area, Gore, Southland ..	..	..	..	37	47	..
W. Blick, Springlands, Marlborough ..	..	..	..	..	22	..
W. J. Crozier, Mitcham, Canterbury ..	..	..	..	..	24, 43	52
Experimental Farm, Winton, Southland	..	..	..	..	26, 63	..
R. Knibbs, McNab, Southland ..	..	..	..	..	27, 62	..
M. S. Goodwin, Rangiora, Canterbury	..	..	..	..	38	..
W. McLauchlan, Leeston, Canterbury..	..	..	..	..	40, 65	..
D. Marshall, Leeston, Canterbury ..	..	..	..	..	41	..
A. Breakwell, Wakanui, Canterbury ..	..	..	..	..	44, 60	..
A. Spillane, Winchester, Canterbury ..	..	..	..	..	45	53
G. Friend, Gore, Southland	..	..	..	..	48	..
R. Knibbs, McNab, Southland ..	..	..	..	..	49	55
C. R. Sheat, Moneymore, Otago ..	..	..	..	..	55, 66	..
K. Rodger, Tapanui, Otago	..	..	..	..	61	..
High School, Rangiora, Canterbury ..	..	..	..	..	..	50
C. Redmond, Kimberley, Canterbury ..	..	..	..	..	..	51, 67
A. Gibson, North Taieri, Otago ..	..	..	..	..	..	54
L. King, Raukahauka, Southland ..	..	..	..	..	..	56
F. W. Carpenter, Prebbleton, Canterbury	..	..	..	..	..	64

—A. W. Hudson, Crop Experimentalist.
—J. W. Woodcock, Assistant Crop Experimentalist.

Inspection of Milking-machines.—This subject is referred to as follows in the annual report of the Dairy Division for 1930–31: "In districts where Farm-dairy Instructors are operating these officers gave special attention to the inspection of new and renovated milking-plants installed, and elsewhere the inspection was carried out as opportunity offered by the Butter and Cheese Instructors. During the year some 3,125 plants were inspected, the great majority of which were found to comply with the regulations. A few required minor adjustments, and necessitated a further visit before being finally passed. The reduction in the number of Farm-dairy Instructors must necessarily throw more work on the Dairy Instructors in connection with the inspection of the erection of new milking-machines, and any re-erections of used machines. This is important work, and has been the means of ensuring that these installations are such that they can be kept clean without unnecessary care and attention. Since the amending regulation has placed some responsibility on the vending and erecting firm, fewer erections are found to contravene the regulations."

IMPORTATION OF SELECT GRAPE-VINES.

THE grape-vine varieties detailed in the following lists were imported by the Department of Agriculture during the past year and planted in the experimental vineyard at Te Kauwhata Horticultural Station to test their suitability for New Zealand conditions.

Under the heading of "Ripening Period," the letter "P" indicates precocious varieties ripening before the Golden Chasselas, which latter ripens at the end of February or beginning of March; the figure "1" means ripening at approximately the same time as the Chasselas; "2" in the middle of March; "3" towards the end of March and in the beginning of April. The exact period of ripening varies with seasonal climatic conditions, varying aspects, &c.

Variety.	Colour.	Ripening Period.	Remarks.
Central European Varieties from Vienna.			
Green Sylvaner	Green	1–2	Wine. Heavy bearer. Produces a light agreeably flavoured wine. Extensively grown in Austria and Czecho-Slovakia.
Fröhlich-Sylvaner	Green	1–2	Wine. A selected Green Sylvaner.
Riesling × Sylvaner (Müller-Thürgau)	Green	1–2	Wine. A new variety, combining quality with quantity. Being planted extensively in Central Europe and Switzerland.
Green Veltliner	Green	P, 1	Wine. Abundant production of wine having a fine bouquet.
Red Veltliner	Red	P, 1	Ditto.
Brown Veltliner	Brown	P, 1	Ditto.
Neuburger	White	P, 1	Wine. A new variety, producing excellent wine. Good bearer.
Zierfandler	Red	1–2	Wine. Except for colour, the wine is identical with that of the Green Sylvaner.
Rotgipler	White	2	Wine. Very heavy bearer, of good-quality wine. Suitable for north-east slopes in the warmer parts of New Zealand.
Erzerzo (Best of All)	White	1–2	Table and wine. Abundant production of good wine. Juice very sweet.
Mezes (Honey Grape)	White	P	Table and wine. Heavy cropper. Wine ordinary. Good table fruit. Exceptionally sweet.
Muscat Ottonel	White	1–2	Table and wine. Muscat flavour.
Perle de Csaba	White	P	Table. An exceptionally early and excellent Muscat-flavoured grape.
Ezereves	White	P, 1	Table. Remarkably large bunches and berries, resembling a white Gros Colman. Excellent flavour.
Vines received in Exchange from the South Australian Department of Agriculture.			
Red Hanepoot	Red	2–3	Table. A red Muscat of Alexandria. A South African production.
Brown Muscat	Brownish-red	1–2	Table and wine. A better bearer than the Muscat de Frontignan. Stronger in flavour, but not so delicate. Possibly identical with the Muscat Rouge de Madère imported in 1929 from France.
Quick's Early	White	1	Wine. A good variety from South Australia.
Black Monukka	Black	2	Table. Large bunches of medium-sized berries. Pleasant flavour. Almost seedless.
Gros Lot	Black	1–2	Wine. Heavy cropper. Produces a good "vin ordinaire" in the Tourraine District of France.
Bellino Nero	Black	2	Table. Large handsome bunches and berries. Excellent flavour.
Melon	White	1	Wine. Suitable for clay soils, on which it produces abundance of a Chablis type of wine. Spur pruning recommended.
Malegue 51–20	White	2	Table. A direct producer. Good bearer of large bunches and berries. Muscat flavour.
Riparia × Cordifolia-Rupestris 106–8	..	..	Resistant stock. Very vigorous. Recommended for compact, dry, and poor soils containing little lime. Affinity good with most varieties.

Previous lists of recently imported varieties were given in the February, 1928, and October, 1929, issues of this *Journal*.

—J. C. Woodfin, Vine and Wine Instructor, Horticulture Division.

SEASONAL NOTES.

THE FARM.

Pasture Management.

In general, until comparatively recently, so long as there was plenty of unconsumed growth on pastures in summer, farmers were quite satisfied they were efficiently meeting the needs of the situation, although at times the more thoughtful among them were sorely puzzled in their attempts to provide themselves with a line of reasoning which would satisfactorily explain why the production of stock fell off at a rate unduly rapid, in view of the fact that the stock seemed to be in the midst of plenty. We now know that more attention should have been given to the quality of the feed which is governed to a large extent by the stage of maturity.

Usually in January and February any weakness in the pastures as a source of feed for "wet" stock is more likely to be in respect to quality than to quantity—the feed provided by grassland at this season frequently is undesirably woody, and consequently of the low feeding-value associated with a long and mature condition of growth. This year in certain parts, because of the unfavourable season, there was not the usual amount of surplus feed to bring about the falling-off in the quality of the late summer feed to the usual extent, but, nevertheless, some farmers will be faced with the need of adopting all practices which will give feed of good quality for milk-production.

The primary need is for leafy growth, which is not naturally produced by pastures in late summer. Topping of pastures with the mower in February may be advisable in the interests of feed-quality; if the growth is rank and flower-heads have developed, mowing will tend to induce fresh leafy growth from the base of the topped plants. Mowing may also be advisable because of the presence of such weeds as spear thistles, docks, fat-hen, and willow-weed or red-shank, which, by their shading influence, tend to appreciably weaken useful constituents of a pasture. Indeed, the detrimental effect of shade-creating weeds, if not checked, may be so great as to lead to the destruction of individual useful plants and their eventual replacement by weed species.

Top-dressing with phosphatic material in the latter part of the summer or in early autumn is also likely as a rule to stimulate leaf-production in an advantageous manner. When the rainfall is adequate the application of phosphates at this season quickly stimulates growth, while if dry conditions follow the distribution of the phosphate its beneficial influence will be delayed, but not lost. Further, phosphates applied at this season may ordinarily be depended upon to stimulate growth appreciably in the following spring, and—a point in favour of the practice—they will not so markedly stimulate growth in the following summer, when it is often a task to control it properly, as they would if applied in July or August.

Both the top-dressing and the topping in the manner specified tend not only to give more leaf growth than would normally occur at this season, but also to level out the feed-supply available from the pastures throughout the year, and this, equally with quality in the feed, should be one of the objectives of modern grass-farming.

Quality and evenness in the supply of feed from pastures are having more attention given to them than in the past. There is solid reason for this: our need for them has grown as our knowledge relative to them has grown. There has been a tendency to depend more and more upon pastures

as a source of feed for stock, and this has been at the expense of crops, such as soft turnips and rape, which are markedly low in woodiness and high in digestibility. It is to be expected that the pastures, if they are to replace such crops successfully, must provide feed with essential characters similar to those provided by these crops. And this is what is proving to be the case in practice—only leafy pasture-growth, low in woodiness and high in digestibility, can efficiently replace standard successful summer supplementary crops. Whether such leafy pasture-growth should be made wholly to replace summer supplementary crops is a management or economic question about which we are not at present directly concerned. That it can, if necessary, efficiently replace such crops is a fact of animal nutrition that has been amply demonstrated, and we know definitely that as a rule pastures in summer should be kept as leafy as possible.

Pasture Establishment.

At times the preparation of ground for autumn sowing of pastures is not commenced early enough to allow of the most economical production of the firm fine seed-bed which is essential for the obtaining of full success from the use of suitable seed and manure. The process of natural weathering can be a considerable aid in the production of such a seed-bed, but it requires time and, partly because of this, farmers generally should proceed with the preparation of seed-beds for pastures as soon as practicable.

The matter of pasture seed mixtures will be considered in some detail in next month's notes. In this connection the recent development of most practical moment is probably the recognition of the paramount importance of using truly perennial strains of rye-grass, and, as supplies of certified seed will be available when sowing-down is being done, there is no real justification for the use of inferior strains of rye-grass when the permanence of the new pasture is desirable.

The results of the more recent work point also to the conclusion that in the past money has been wasted on account of the use in seed mixtures of some species which served no useful purpose. The present tendency is to reduce the number of species and so lower the cost of mixtures. Details may be obtained from officers of the Fields Division in the various districts.

In districts where the grass-grub is in evidence it is not a safe practice to sow down pastures after a cereal crop or a grass crop. On the other hand, land which was free from plant-growth in November and December is very likely to be free from grass-grub infestation, especially if it was not previously infested with the grub.

Critical Summer Feeding Period.

Frequently the January–February period is marked by a fall in dairy production much greater than may reasonably be attributed to natural causes, such as the advancement of the milking season, and observation has shown that this fall is almost invariably linked with poor feeding. If proper measures were not taken earlier not a great deal, apart from the pasture-management measures already considered, can be done at this stage to avoid this most unwelcome fall. However, it is worth remembering that at times certain crops may advisedly be fed for the purpose of obviating an excessive fall, even though these crops if left longer would give greater yields. For example, a partly grown crop of soft turnips fed at this stage when it is badly required may prove of greater value than it would if fed when it is fully grown, but not so badly needed. In addition to turnips, crops of young succulent lucerne, red clover, maize, and millet may suitably be fed now, but if such crops are allowed to become mature and woody they develop the same weaknesses as stemmy grass.

Seasonal Work with Lucerne.

It is at times advisable in February to mow young lucerne which was sown in November or December. This is generally due to a vigorous development of weeds which tend to choke the lucerne seedlings, but if there is no evidence that the lucerne is in danger of being harmed by weeds then there is no need to carry out the first mowing early, for during the young stages of the crop unchecked leafage assists materially in building up an extensive root-system, which is apt to serve well in subsequent critical periods.

Good results may be expected from top-dressing lucerne with phosphates in summer. As a rule, summer top-dressing of lucerne is preferable to spring top-dressing, which under some circumstances may benefit, equally with the lucerne, invading plants which it is desired to suppress.

As a rule, a suitable time for the cultivation of established lucerne is after the second cut of the season; the primary object of cultivation is usually destruction of weeds, and the dry weather which is commonly experienced at about the time of the second cut assists this appreciably.

At times good results are obtained from sowing lucerne in February. Good germination is favoured by the warmth which the soil then possesses. One reason for February sowing is the avoidance of the competition of those annual weeds, such as fat-hen, which germinate in the spring and tend to hinder the strong establishment of spring-sown seedlings. Generally, however, November–December sowing of lucerne is favoured on the basis of results.

Late-sown Turnips and Catch-crops.

In several localities turnips may still be sown with the prospect of quite satisfactory results. Suitable varieties for use at this stage are Imperial and Hardy Green Globe and White Stubble. Swedes are less satisfactory for late sowing, because of the greater possibility of severe attacks by insect pests, and this especially should a dry autumn occur.

On many farms there will be opportunity for useful catch-cropping, which promises to be particularly advisable this year because of unusually low reserves of hay, silage, &c. Land in oat stubble, for instance, if worked as soon as the oat crop is removed and then sown without delay in Western Wolths or Italian rye-grass and red clover is likely to provide considerable green feed, which, as a rule, is very welcome to sheep-farmers working under Canterbury or similar conditions. Black skinless barley also, sown after oats at the rate of 2½ bushels an acre, develops so quickly that it will provide good feed for dairy cows or sheep at a time, about two months later, when it is much required. Algerian oats are useful for providing later feed. With all these crops it is as a rule profitable to apply (at the time of sowing) superphosphate at the rate of 1 cwt. to 3 cwt. an acre, according to the natural fertility of the land.

Importance of Summer Cultivation.

One of the major weaknesses of cropping-work in New Zealand farming is the neglect of surface-cultivation during summer. All crops such as potatoes, mangels, carrots, maize, &c., sown in rows wide enough to allow of intercultivation respond profitably to it, carried out at regular intervals as long as it is possible to work between the rows. It is impossible to say what interval should occur between successive cultivations, for a beating rain immediately after one cultivation may cause the surface of the soil to cake and make it advisable to cultivate again as soon as possible. Cultivations should certainly be frequent enough to maintain the surface layer of soil in a loose condition, and to do this, particularly in dry climates, it may be advisable to cultivate even though weeds are not at all prominent.

The main object, in the absence of weeds, is primarily the conservation of soil-moisture, which is a more weighty factor in the production of crops than many seem to realize.

Summer Weed Control.

The late summer usually offers considerable opportunity for endeavour directed at weed-suppression. In the first place, certain crops such as potatoes, mangels, and carrots are kept reasonably free from weeds right up to midsummer, but after this weeding generally does not receive attention. It certainly does not call for as much attention as it did earlier, but it does call for some, otherwise a late batch of weeds will most likely produce seed. Though this will probably be a really light invasion of weeds insufficient to appreciably lower the yield of crop, it will be heavy enough to produce a host of seeds which will copiously foul the ground for succeeding crops, and herein is the great damage that should be avoided, otherwise so-called cleaning crops such as potatoes and mangels will virtually become fouling crops.

Summer fallow or prolonged summer cultivation, by itself, generally is no longer looked upon as a satisfactory or economical means of suppressing "twitchy" weeds such as couch-grass, yarrow, and Californian thistle. While summer cultivation is of undoubted value in weakening such weeds, and on that account should be practised, particularly in the drier parts, it seldom brings about the complete eradication of these weeds—sufficient live remnants remain to form the basis of future heavy reinfestation of the land. For economical results the summer tillage should be linked with other suitable measures which will continue the weakening of the weed population that was initiated by the cultivation. For instance, if considerable summer cultivation is followed by a dense autumn-sown crop the injurious influence of the cultivation will be continued on account of the shading occasioned by the crop, and, if necessary, a further dense crop may be grown to continue the detrimental shading until the weeds have been destroyed. The essence of economic weed-control of this type is to take care that the shading crops are themselves also profitable ones.

—R. P. Connell, Fields Division, Palmerston North.

Fattening Lambs on Rape.

The rape crop is almost entirely one for the sheep-farmer, and provides a useful supply of feed for lambs when the grass begins to go off. Late lambs can be fattened for the freezing-works on rape, its fattening capacity comparing well with other crops used for this purpose. It is usual to combine mustard with the rape to act as a corrective.

It is usual to feed off the crop in breaks, a run-off on grass being provided. When a change of pasturage is used for any class of stock it is advisable to bring about the change gradually, allowing a few hours' grazing at first until the stock becomes accustomed to the new feed. To prevent bloating and occasional deaths it is also preferable to commence using the crop after a spell of dry weather rather than after rain. The lambs should have access to rock salt.

A good crop may be grazed early, closed up for a bit and grazed again, even a third period being obtained in some cases. The mistake is often made of allowing the rape crop to become too mature before turning lambs on. The plants are then woody and unpalatable, and are not eaten with the same relish as a younger crop.

Assuming average conditions, both in regard to the crop and the lambs, a fair proportion of fats can be drafted off the rape after a period of three to four weeks' grazing. In this respect it must be remembered that the most desirable dressed weight for fat lambs for export lies between 32 lb.

and 36 lb., the overseas demand being for small joints. Another point is that second-grade lambs may be found in almost any weight, a good deal depending on the conformation of the lamb and the amount of condition necessary to give it the proper finish. Also, a perfectly finished lamb may be second-graded for bruising owing to rough handling.

Depending on the district and the crop, rape is used after weaning has taken place. The main object is to keep the lambs from receiving a check; if the other feed is scarce it may be advisable to wean earlier, in other circumstances later. Much depends on the feed available up to the time of weaning.

Rape-scald: This condition, which is sometimes met with, is an inflammation of the skin (dermatitis) affecting the skin of the ears and, in some cases, extending along the back and sides of the body. The ears become swollen and pendulous and inflamed areas appear on the back where the skin becomes thickened and may become detached from the underlying tissues. The condition appears to be due to a photosensitization of the skin due to the sun's rays and is more commonly seen among lambs which have been shorn, the absence of wool leaving the sensitive skin open to the effects of the rays which are responsible. The condition may be seen among other lambs and sheep, but very rarely. Although this condition may be met with and must be mentioned here so that owners may be able to recognize it without undue alarm, the condition is really one of extreme sun-burn. If considered advisable the affected lambs can be moved off the rape for a day or two.

—J. E. McIlwaine, Live-stock Division, Wellington.

THE ORCHARD.

Spraying Operations.

In most districts there is a heavy flight of codlin-moth about the middle of February, which must be guarded against by an application of arsenate of lead during the second week of that month. Add Black Leaf 40 if there is any sign of leaf-hopper making its appearance. Powdery mildew—in some districts the worst apple-tree disease we have—will require constant attention by the use of lime-sulphur plus a finely divided sulphur. Such a combination will also assist against black-spot infection of apples and pears. Owing to the dry season so far experienced in most localities the crop is very clean, but growers must not be lulled into a sense of security by this general immunity from black-spot. Protection must be given to leaves and fruit to avoid late infection of "pin-point" black-spot, which is liable to occur as the result of dewy nights and humid autumn weather.

With the low rainfall and high temperatures which have been generally experienced red mite is reported from almost every district to be very aggressive this season. Steps, in some cases drastic steps, must be taken to control it at once, in order to assist the maturing crop and to ensure reasonably clean trees for the coming season. Now, before the winter eggs are laid on the bark of the trees, is the time for such a clearance, and growers are strongly urged to spray immediately, as previously advised, for the control of this pest, which is capable of doing so much damage to the crop and trees.

Orchard Hygiene.

The destruction of material—fruit, shoots, and limbs—infected with such diseases as brown-rot, silver-leaf, fireblight, codlin-moth, &c., should never be neglected however busy the grower may be, otherwise he is only storing up trouble for himself for future seasons. The disinfection of second-hand trays used in some districts is also a wise precaution, especially in those localities where brown-rot is at present not a serious menace.

Cultivation, Irrigation, and Cover-cropping.

Attention is directed to the advice tendered in these notes during the last few issues of the *Journal*, with an especial urge to growers in Central Otago to sow cover-crops and to keep up their irrigation during the succeeding dry months of late summer and autumn.

Budding.

With the decreasing flow of sap and the maturing of the buds, February and March are suitable times for budding. In Northern districts late budding is usually very successful, as the danger of flooding and commencement of growth when the sap is moving freely is over. In the South, where early autumn frosts are liable to occur, it is safe practice not to leave the operation until late in the season. Instances have occurred in Central Otago where trees budded in late March were affected by a frost a night or two after. Considerable loss—up to 90 per cent.—was occasioned through the frosting of the buds before a proper union had been made between bud and stock.

The main factors to consider in budding are (1) a steady flow of sap in the stocks to ensure, without flooding or commencement of growth, the early knitting together of the cut surfaces, (2) mature wood buds of the current season's growth (avoid taking buds from either end of the shoot), (3) quickness of operation so as to avoid drying out of the cut surfaces of bud or stock, and (4) firm tying of the bud.

Harvesting the Stone-fruit Crop.

Growers would be well advised to consider the prices received already for the earlier fruits. This season the difference in price for first-class fruit and that obtained for inferior stuff has been more marked than usual, and with the lower purchasing-power of the public this is likely to be still further accentuated as the rush of the season approaches. Keep the standard high and consistent, and make every endeavour to place the fruit on the market in good condition, free from marks and bruises, and in an attractive package.

Export Preparations.

Packing for export will have commenced before the next issue of the *Journal* is in the hands of growers, and everything should be in readiness for the coming rush. If the good name which we have built up for our fruit overseas is to be maintained all sources of deterioration must be eliminated. The bigger items are usually well attended to, but some of the smaller factors are liable to be overlooked and will be discussed in next month's notes. In the meantime let every care be taken right from the picking through the various operations, large and small, until the fruit is finally shipped.

—W. R. Lloyd Williams, Orchard Instructor, Alexandra.

Citrus Culture.

Cultivation should receive very close attention at this period. The land should be worked to a fine tilth as early as possible, and this maintained. Citrus trees in particular require constant cultivation to conserve moisture, as they make the greatest demand on the soil during the period of minimum rainfall. If it is not possible to maintain a fine tilth on the earth-surface, the trees should be mulched to at least the spread of the branches with rough litter or manure. When mulching one must exercise care and not pile the material up against the trunk, as this is liable to cause decaying of the bark and injury to the tree.

Young shoots which become extended in growth should be pinched back to encourage side lateral growth. If left to mature these shoots often grow to 3 ft. or more before subdivision takes place, and then side laterals grow only on the extremity, leaving an undue length of wood unfurnished. By pinching out the point of these shoots as suggested laterals are forced nearer the base and growth encouraged where it is most useful, and not where it is naturally disposed to grow.

Humid conditions suitable for the spread of verrucosis will necessitate a further spray of bordeaux 4–4–40 if the advancing crop is to be maintained clean.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

The Growing Pullets.

SPECIAL attention should now be given to the feeding and general management of the growing pullets, for upon the attention received by them at this period will largely depend the profits to be secured during the winter months. It must be emphasized that to attempt short cuts to early and heavy production is a big mistake. While meat in some form is a most valuable item in the diet of the growing bird, it should be used with the greatest of care, for meat, especially when fed too liberally, may do as much harm when used at the wrong time as it will do good when employed at the right time.

The most harmful effect of overfeeding meat is frequently seen among young stock, which, instead of growing into good-sized and vigorous birds, have been forced to maturity before they have attained anything like the standard weight requirements of the breed they represent. By this it is not implied that size alone should be the main object aimed at, for that can be easily overdone at the expense of the egg-basket. Early maturity is certainly desirable, but only when the bird has attained a complete stage of development which conforms to the standard weight of the particular breed represented. I have frequently seen White Leghorn pullets commence laying when a little over four months old, and even Black Orpingtons which produced at under five months. Obviously such stock are undesirable, chiefly for the reason that when a pullet starts to lay she ceases to grow and will never attain a desirable size for breeding purposes nor produce standard-sized eggs for the market.

The value of a pullet is determined mainly by the number of eggs she will produce in the dear season under adverse conditions and while her product is of good saleable size, not by the fact that she commences to lay at an early age. Therefore, when pullets show indications of prematurity it will be found a wise course to feed meat, meat-meal, &c., sparingly, or perhaps entirely eliminate such forcing foods from the ration during the growing stage; this applies with equal force to skim-milk, milk-curd, &c.

It must be admitted that even in the best-managed flocks some pullets will prove to be more precocious than others, but the former are hardly likely to prove really profitable stock for they are liable to moult just before the dear egg season commences. On the other hand, the well-developed pullet hatched at the right time, and which commences her season of production about April, can usually be depended upon if properly fed and handled to continue laying for the greater part of the year, and after proving a profitable bird in her first laying season, will moult in time to produce a good egg-yield during the following year and eggs of a size desirable for incubation purposes.

Generally speaking, with White Leghorns between six and seven months is the best age for a pullet of a laying strain to start on her season of production, and this may be extended for a month in the case of Minorcas and the heavier breeds. If winter eggs are to be secured in good numbers it is important that the pullets should be in their laying quarters well in advance of the commencement of the laying period.

Changing the quarters of the pullets just before or at the commencement of the laying period is the surest way of bringing on a false moult and thus rendering the flock unprofitable. The pullets should be accommodated in quarters which are roomy and comfortable, but at the same time airy. It must be remembered that the season for high-priced eggs is being more and more curtailed as compared with previous years, and it therefore becomes increasingly important that the pullet intended for winter egg-production should be handled with the greatest care, so that she can be depended upon to lay just when required. Do not experiment, and remember that the pullet has been bred out of its natural season, and is expected to produce her maximum yield of eggs at a time when nature meant that she should rest.

Especially is it necessary in these days of dear foodstuffs to have birds producing a good yield of eggs during periods other than the natural laying season. At the present season there is hardly a poultry-keeper to be met with who will not declare that all his birds are laying well. It is very different, however, in the winter months when eggs are returning the best price; only those who have good stock, hatched at the right time, and who give their pullets never-ending care and attention, can then boast of big egg-yields. Even with pullets hatched at the correct period of the year, draught-proof but well-ventilated houses kept in a thoroughly clean condition, and the provision of ample accommodation for exercise, green feed, clean water, broken sea-shell, sharp gravel grit, and a generous supply of food with a proper proportion of animal food (given separately if possible) are indispensable if winter eggs in large numbers are to be secured.

Day-old Chicks.

One of the most unsatisfactory features connected with the day-old-chick trade is the mistaken idea held by many purchasers that if the young birds fail to thrive and do well they must necessarily have been bred from weak parents. It may be true that chicks are sometimes sent out that are difficult to rear, but before placing all the blame on the supplier of the chicks it would be well for those who experience trouble in this direction to ask themselves if they have not been inviting failure by neglecting some essential detail or leaving too much to the brooder.

The following is a case in point. Recently a number of chickens which had been purchased from a specialist breeder as day-old chicks were brought to me and my advice sought regarding their failure to thrive and make sound development. When I examined the birds the cause was plain at a glance, for they were overrun with insect pests. From inquiries made it was ascertained that the young birds were being reared in a house where adult stock had recently been accommodated, and that the cleaning operations were not as thorough as they should have been before the chicks were placed there. Obviously, to subject the young birds to such conditions was simply courting disaster. Even if chicks are bred from the best birds on another breeder's plant, and not from culls, they must be reared under the best conditions if they are to thrive and develop into profitable stock.

Success in rearing chickens by artificial means depends upon attention to many details, but there is one detail in particular that must be strictly observed, and that is cleanliness. Unfortunately, many people who attempt

to rear artificially hatched chicks have no idea as to what cleanliness really means, and fail to realize that dirt is the forerunner of disease and parasitic infestation.

One of the strongest points in favour of an incubator is that it does not breed vermin, the source of probably one of the heaviest leakages in the business of poultry-keeping. Chickens will sometimes make more or less sound development with the natural mother, even when affected with vermin, but where chickens are in a brooder vermin are practically fatal to their welfare, and especially is this the case with red mite. When growing stock are to be placed into a house where adult birds have recently been accommodated one cannot urge too strongly the necessity for giving the quarters a through cleaning, followed by a good spraying with strong disinfectant, so that the young birds will be safe from the infestation of the vermin which are usually found in the ordinary fowlhouse at this season of the year.

The incubator-hatched chick under ordinary circumstances should go right through its developing stage without having to contend against vermin, and it should be remembered that a young bird receiving a check from this cause will never develop into the best type of adult. Instances could be multiplied where good stock and their owners have been condemned because the purchasers failed to give the birds the proper attention themselves.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Extracting Operations.

By this time, provided weather conditions are favourable, extracting will be in full swing in all districts. There may be two or more extractings during the season, or the honey may be left in the hives till the close of the flow, and the whole crop removed at one time. In the latter case the bee-keeper needs an ample supply of supers and combs, and must watch attentively that the hives do not become honey-bound and the bees commence loafing. The better plan is to have two or three extractings during the season, removing at the first operation all combs in which the honey is wholly or three-parts sealed. When these are emptied and returned to the hives the excluders should be brought into use if they are not already in the hives.

Hot sunny weather should be chosen for the work, as on such days the honey runs freely and the bees are good-tempered. A good plan is to remove the honey in the morning, stacking the supers in the honey-house as they are removed, preparatory to extracting in the afternoon. By this method all stray bees can be removed before the actual extracting commences, and the operator can work quickly and peacefully at emptying the combs till the evening, when the empty combs can be returned to the hives. By the morning the bees will have settled down and returned to the task of refilling. "Keep the extractor running" is a good maxim once the work has commenced, and every hot day should be utilized for gathering the harvest.

Removing Honey from the Hives.

Honey should not be removed from the hives until it is well ripened. When the surfaces of the combs are a half to three-parts capped the honey is usually sufficiently ripe to extract with perfect safety. In Northern districts the practice of taking off "green" honey, to be afterwards ripened in the tanks, has been to some extent carried out, but the humidity of the climate must be the deciding factor. In Southern districts such

procedure would be dangerous, and care should be exercised and only well-ripened honey taken. By taking unripe honey fermentation will often result, rendering it unfit for consumption.

When the time for extracting is at hand the usual practice is to remove the combs one by one, and to brush or shake off the adhering bees. As the combs are relieved of the bees they should be stacked in a super, to be afterwards removed to the honey-house. It is a wise precaution at all times to place a cloth over the combs in the super, and if there are any signs of robbing it is a good plan to use a damp cloth which has been previously immersed in water containing a small percentage of carbolic acid.

Use of Strainers.

Some form of strainer should be adopted to catch the larger particles of wax, dead bees, &c., in the honey as it leaves the extractor and before it finally reaches the tank. It is a simple matter to strain the honey, and yet this important part of the work receives less attention than its importance demands. It should be the aim of every beekeeper to see that his product is rendered as marketable as possible before it finally reaches the customer, and thus create a name for a high-class article. Wax is not a component part of honey, and dead bees are foreign matter, and yet they are frequently found in honey exposed for sale. Honey containing either is not likely to suit the buyer, and its selling-value is consequently reduced.

To ensure all but the smallest particles of wax will be removed the honey should be run through a fine wire strainer, and finally passed through fine cheesecloth before entering the tank. Cheesecloth strainers are cheap and easily made, and should be cleansed after each day's operations. The strainers should be of such construction as to be easily cleaned, and if the cloth is tacked into wooden frames the operation is greatly facilitated. Use cold water when cleansing the strainers; hot water melts the particles of wax, thereby clogging the holes in the cloth, whereas cold water removes all wax from the surface. Hang the strainers up to dry, so as to be ready for use when required.

The Honey-tank.

No part of the apiary equipment is of more importance at extracting-time than a good tank. From the strainers in use it is advantageous to run the honey into a tank, so that the small particles of wax that pass through the strainers will rise to the surface, when they can be skimmed off before finally drawing the honey off at the bottom of the tank. Many beekeepers run their honey direct from the strainers into tins and small packages ready for sale, with the result that the small particles of wax rise to the surface, to the detriment of the honey and its sale. Frequently complaints are made as to the quality of the honey, and not infrequently adulteration is suspected through an excess of these wax-particles rising to the surface. Such honey should not find its way to market, its condition having been brought about by sheer neglect to provide adequate tank accommodation. By allowing the honey to settle in the tank the air-bubbles escape, the small particles of wax rise to the surface, and in dry weather surplus water is evaporated.

The size of the tank to be adopted must be decided by the beekeeper himself, as it is hard to find two with requirements alike in the matter of honey-tanks. He must study his needs and convenience, but in any case the tank should hold enough to enable him to deal with the honey in the hives at the time of extracting.

Cleanliness in the Honey-house.

It should hardly be necessary to point out that the greatest care must be taken in preparing honey for market. However, it is by no means an uncommon thing to come across cases where the beekeeper appears to have lost sight of the fact that honey is a food, and, what is of more importance,

a food which is eaten uncooked. Everything in the honey-house should receive the same attention as dairy utensils. The extractor and tank cannot be washed out every day during the season, but they should be thoroughly scalded before commencing operations, and whenever honey is allowed to remain in them they should be covered with clean washing-covers. These cost little, are easily made, and should be very much in evidence throughout the season. On no account should bees, flies, dust, or other foreign matter be allowed to alight on the honey in the tank, and as soon as extracting is finished for the day the extractor should be closely covered with a cloth. Finally, as a fitting close to the day's work, the floor of the extracting-room should be washed and every drop of honey spilt during the day removed.

Treatment of Foul-brood.

The work of putting colonies under treatment where foul-brood is detected should not be postponed. The season is a short one, and every effort should be made to winter only clean hives. The risk of having the disease spread by robbing during the off-season, when it is most likely to break out, will lead to endless work in the spring unless the beekeeper is in earnest in checking its spread during favourable conditions. No better plan can be followed than to treat all infected colonies by the McEvoy method during the late flow. Many beekeepers are too ready to postpone treatment, only to find in the spring their hives weak in bees, and consequently in poor condition for successful treatment. No half-measures should be adopted when dealing with foul-brood, and in all cases the "double shake" should be practised if the disease is to be entirely eradicated.

A good plan to follow if any doubt exists as to the complete absence of the disease is to mark all infected colonies, and to leave them to be finally dealt with after the clean colonies are extracted. In any case the combs should be marked with the number of the hive to which they belong, so that when they are extracted they may be returned to the colony from which they were taken. If these precautions are taken the risk of spreading disease by means of wet combs is minimized.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Maintaining Soil-fertility.

A LIFE'S experience devoted to the cultivation of the soil develops an instinct in the judgment of soil-fertility. Smell, sight, and touch contribute valuable evidence in arriving at conclusions, but when an experienced grower states that his land "is turning up badly" he means as a rule a great deal more than he can express. The final ploughing, which is the main feature in the culmination of the preparation of the land for springtime planting, is important in that the cultivator can then estimate the quality of this preparation, for on that more than on anything else the success of the crop depends. The reaction will vary in the case of soils of different kinds, but one that is known to be free from weeds, well supplied with plant-foods, of a dark shade of colour and of a light fibrous texture for a depth of a foot or so, may generally be expected to give good results—that is, if the seed used is of a good strain and the climatic conditions during the season are normal. If any of these conditions are lacking the resulting crop will suffer.

The conditions which are most difficult to maintain in land under continuous cropping, and that are as a rule generally deficient, are those which come under the heading of physical conditions. The soil turns up sticky and lumpy, it dries out quickly, and becomes harsh and dry. Such a soil may be given—and it generally receives—heavy dressings of expensive

fertilizers, but still the crop is comparatively low in quality and quantity. The fertilizers supplied, and much of the natural foods in the soil, are not available to the plant to anything like their full extent. As plants take their food only in solution a constant supply of water is necessary, and soil in a bad physical condition is sticky and stagnant while wet, dries out rapidly, and is wetted again only with difficulty. A constant supply of water and steady soil temperatures can only be maintained by keeping the soil well supplied with humus—material formed by the decomposition of animal or vegetable matter. In addition to the plant-foods it contains there are the carbon and fibre which lighten the soil and give it that spongy condition which retains moisture and keeps it sweet; and whatever foods are present are readily made available in greater quantities.

This difficulty is typical of modern conditions; stable manure upon which growers in the past chiefly relied for humus is not available, and land is often too high-priced to permit it to be devoted for two or three months to the production of green cover-crops for ploughing in, and artificial fertilizers are applied in increasing quantities. If the land is heavy and deep this drawing on the capital, so to speak, may continue for some time as the resources are comparatively extensive; but where the land is inclined to be light the humus present is more quickly used up owing to rapid oxidization, and the bad physical conditions causing sterility quickly arrive.

It is just as well to realize that there is nothing to take the place of humus, and constant cropping, such as is practised by most market-gardeners, cannot be maintained without it, no matter what artificial manures are used. The most that modern research has been able to do as regards this problem is to wet straw and ferment it rapidly to bring it quickly to a desirable state for dressing the land. This is of great help, where straw is available, and further suggests that grass, weeds, and vegetable growth generally growing on waste areas should be cut with a mower shortly before seeding, stacked in a moist condition, and fermented for application to the land at a convenient time. This would have the additional advantage of cleaning up rough corners and should facilitate weed-control.

Apart from such resources of humus, the only other methods generally available are to adopt a rotation which permits the land to be grassed and grazed for three years or so, or to grow green cover-crops and turn them in. The former is an excellent method and specially suited to lands that are rather light. Such a soil is often excellent for the production of early crops, but will not stand the constant cropping done on heavier lands. These latter may sometimes be kept in condition with, say, one good cover-crop turned in in three years. To do that one-third of the area should be cropped in this way each winter. A medium loam over a shingly subsoil—rather inclined to be overdrained—would benefit from a heavy green crop turned in annually.

In estimating the cost and profits under either of these systems, it should be realized that a good supply of humus must be maintained in a soil to keep it fertile, and nothing else can take its place. If this were done a quarter or less of the artificial manures commonly used would be more effective than the larger amount, owing to the better conditions for making them available to the crop. Artificial fertilizers will not take the place of humus.

Vegetable Crops.

Important sowings for this month are Globe beet, Shorthorn carrots, dwarf beans, peas (of an early variety at this season), spinach, salads, and turnips. Harvest shallots and onions as soon as the tops begin to turn yellow; also potatoes as soon as they ripen. The quality of many crops is depreciated by delaying this operation. Do not allow marrows or celery to become dry; a dusting with soot is an excellent insect-powder in the

garden. The celery crop would often benefit from such an application. Most of the spring cabbages and cauliflowers cut during the month of September are sown in February for April planting; these are important crops. Sow now also mild white onions for salads.

Small Fruits.

Preparation of the land for planting berry fruits should be completed as soon as it is available after the present preliminary crops—whatever they may be—are lifted. Cut, carry out, and burn the fruited canes of raspberries and logan-berries. Spray the new canes and bush fruits generally with a mixture composed of bordeaux and arsenate of lead, so that they may be thoroughly clean during the dormant season.

The Homestead Garden.

Last month's notes dealt with shelter and shade trees in the garden selected from our native evergreen plants, which are more suitable than any others for those purposes. A sheltered setting of evergreen trees and shrubs having thus been planned, the more showy climbers and shrubs for foreground planting have to be considered. It would be mere prejudice to suggest that nothing but New Zealand plants should be used for this purpose, but certainly all that are worthy should be included if they are suited to the locality. There are a surprising number of species of high merit which will be better still after some years of careful selection among seedling varieties followed up by vegetative propagation.

When forming this season's planting-plans the following should receive consideration for such positions: Among climbers the white-flowered clematis of early spring, puawananga (*Clematis indivisa*), followed later by the highly scented kaiku (*Parsonsia heterophylla*), and the passion-flower, kohia (*Tetrapathaea tetrandra*), with modest flowers followed in autumn by large orange-coloured fruit of very attractive shape. These climbers are best displayed on evergreen trees of moderate height, with which they thrive on the most agreeable terms.

Among shrubs some of the most showy are *Clianthus puniceus*, the kaka's beak, red, white, or pink; the lace-barks or ribbon-woods, *Hoheria populnea* and *Gaya Lyalii*, which display their large white blossoms in summer; when also the pink and scarlet blossoms of pohutukawa (*Metrosideros tomentosa*) make large sheets of colour. Among the most highly scented is mairehau (*Phebalium nudum*); it is of moderate height and most attractive in summer, when its white, scented flowers bloom. The dwarf tainui (*Pomaderris elliptica*) may be included in this class, also the red manuka (*Leptospermum scoparium Nicholsii*), and that finest of our spring-flowering shrubs and small trees, the kowhai (*Sophora tetraptera*).

The present time is most suitable for planting spring-flowering bulbs and such lilies as the Christmas lily (*Lilium candidum*), which like a moist well-drained loam and to be left undisturbed once it has established itself.

Towards the end of February is the beginning of a short period when sowing-down new lawns is best done in most parts of the country. Where the land has been fallowed during the summer, and occasional cultivation given to destroy weeds, it will have settled down compactly, and comparatively little labour will be required to obtain a clean, consolidated soil with a smooth surface, which is necessary. A shallow tilth should then be obtained by raking the surface and the seed sown evenly in still weather and raked in; ½ oz. to 1 oz. to the square yard is a suitable quantity of seed under average conditions. But the good appearance, which is so admirable in a well-laid lawn, is not merely in a smooth green sward, but also in a well modelled surface with well chosen levels and grades.

—W. C. Hyde, Horticulturist, Wellington.

LICENSED MEAT-EXPORT WORKS IN NEW ZEALAND, SEASON 1931-32.

Name and Address of Licensee.	Name and/or Location of Works.	Beef-killing Capacity per Day.	Sheep-killing Capacity per Day.	Storage Capacity in 60 lb. Carcasses Mutton.
North Auckland and Auckland.				
Auckland Farmers' Freezing Co., Ltd., Auckland	Moerewa	200	2,000	100,000
" " "	Southdown	200	3,000	202,000
Westfield Freezing Co., Ltd., Auckland	Horotiu	200	3,000	218,000
R. and W. Hellaby, Ltd., Auckand	Westfield	250	5,000	180,000
	"	200	1,000	50,000
Gisborne.				
Gisborne Refrigerating Co., Ltd., Gisborne	Waipaoa	150	3,500	270,000
" " "	Kaiti	175	6,000	422,000
Gisborne Sheep-farmers' Frozen Meat and Mercantile Co., Ltd.	Tokomaru Bay	60	3,000	130,000
Hawke's Bay.				
Nelson's (N.Z.) Ltd., Tomoana	Tomoana	150	7,000	150,000
Hawke's Bay Farmers' Meat Co., Ltd., Hastings	Whakatu	80	8,000	140,000
Wairoa Farmers' Co-operative Meat Co., Ltd., Wairoa	Wairoa*	..	..	..
Taranaki.				
Thomas Borthwick and Sons (Aus.), Ltd., Masterton	Waitara	200	2,000	50,000
J. C. Hutton (N.Z.), Ltd., Wellington	Eltham	50	..	25,000
Patea Farmers' Co-operative Freezing Co., Ltd., Patea	Patea	150	3,000	150,000
Wellington.				
New Zealand Refrigerating Co., Ltd., Christchurch	Imlay	200	7,000	203,000
Thomas Borthwick and Sons (Aus.), Ltd., Masterton	Feilding	100	4,000	153,560
National Mortgage and Agency Co. of New Zealand, Ltd. (Head Office, Dunedin)	Longburn	80	3,000	60,000
Thomas Borthwick and Sons (Aus.), Ltd., Masterton	Waingawa	120	5,000	150,000
Gear Meat Preserving and Freezing Co. of New Zealand, Ltd., Wellington	Petone	100	10,000	300,000
J. C. Hutton (N.Z.), Ltd., Wellington	Ngahauranga	120	3,000	120,000
Wellington Meat Export Co., Ltd., Wellington	..	120	5,000	240,000
" " "	Kakariki†	100	2,000	90,000
Marlborough and Nelson.				
New Zealand Refrigerating Co., Ltd., Christchurch	Picton	30	2,000	30,000
Nelson Freezing Co., Ltd., Nelson	Stoke	30	500	50,000
Canterbury.				
Canterbury Frozen Meat and Dairy Produce Export Co., Ltd., Christchurch	Belfast	120	5,000	170,000
Ditto	Fairfield	..	4,500	100,000
"	Pareora	25	5,000	233,000
New Zealand Refrigerating Co., Ltd., Christchurch	Islington	50	7,000	178,440
" " "	Smithfield	50	6,000	300,000
North Canterbury Sheep-farmers' Co-operative Freezing Co., Ltd., Christchurch	Kaiapoi	..	4,000	222,000
Thomas Borthwick and Sons (Aus.), Ltd., Masterton	Belfast	..	5,000	120,000
Otago.				
Waitaki Farmers' Freezing Co., Ltd., Oamaru	Pukeuri	..	3,800	130,000
New Zealand Refrigerating Co., Ltd., Christchurch	Burnside	50	3,500	34,609
South Otago Freezing Co., Ltd., Balclutha	Finegand	50	3,500	200,000
Southland.				
Ocean Beach Freezing Co., Ltd., Invercargill	Ocean Beach	50	4,000	120,000
Southland Frozen Meat and Produce Export Co., Ltd., Invercargill	Mataura	50	3,000	124,000
Ditto	Makarewa	120	3,800	107,000
Tait's Woodlands Meat Co., Ltd., Invercargill	Woodlands‡	..	..	..
Totals	..	3,640	149,100	5,582,549

* Not operating at present; disorganized by earthquake and fire in February, 1931. † Not operating. ‡ Canning only.

—*Live-stock Division.*

WEATHER RECORDS: DECEMBER AND CALENDAR YEAR, 1931.

Dominion Meteorological Office.

NOTES FOR DECEMBER.

DECEMBER was, generally speaking, a pleasant month, with abundant sunshine. There were three periods during which large parts of the country received very beneficial rains. Their value was all the greater owing to the fact that they fell in warm weather. In many cases, indeed, they resembled tropical downpours, and were associated with thunderstorms. At date of writing rain is still badly needed in Hawke's Bay and Poverty Bay, and still more in Canterbury and Central Otago. The higher levels are generally in fairly good condition, but the plains are very dry and feed is scarce. In other parts there is ample feed, and the prospects are favourable.

Rainfall.—Owing to the fact that much of the rain came in heavy downpours of a local character the distribution was irregular. On the whole, however, the more exposed portions of the country tended to have a larger amount than the average for December, while in the interior and in eastern districts deficits largely predominated. Nelson Province experienced a wet month, especially the area round Tasman Bay. Nelson City had 11 in., the highest total recorded in any single month since 1883. North Auckland and parts of the East Cape districts also had much more than the average. The deficits were most serious in Poverty Bay, Hawke's Bay, the Wairarapa, and in Canterbury. In the last-mentioned province the amounts were approximately half only of the December normal.

Temperatures.—There were some exceptions, but over most of the Dominion the mean temperature was high for December.

Winds.—A considerable amount of northerly wind was experienced, especially in the middle of the month, but, since it was generally north rather than north-west, its character was not so unpleasant as usual. In the southern half of the South Island, however, there was a considerable proportion of westerly wind, which accentuated the effect of the dry weather.

Sunshine.—The number of hours of sunshine recorded was generally high, but was below the average at Hokitika and in parts of Canterbury.

Storm Systems.—Most of the rain during the month was caused by storms of cyclonic type, and occurred during three periods. The first was associated with a cyclone which was deep when over the Tasman Sea on the 6th, but which decreased in intensity next day, and, moving north-eastwards, crossed the Dominion at its northern extremity. Rain was widespread and over the North Island almost general, but the falls were in may cases light or moderate. On the whole, it was rather disappointing.

The second spell occurred about the middle of the month. A series of shallow cyclones came from the westward between the 13th and the 21st. At one stage there were as many as five centres in procession. From the 14th to the 17th pressure was high at Chatham Island, and the combination of circumstances was favourable for heavy rain. Strong northerly winds blew, gales being experienced in many parts, especially of the North Island. General rains fell, and the totals for the whole period were practically everywhere heavy. The fact that they were warm rains added to their value. On the 18th thunderstorms occurred in many places, and there were some rainfalls of the nature of cloud-bursts. Flooding was caused by such rains at Masterton, and at Earnscleugh in Central Otago. Similar phenomena were experienced at Dusky, in Southern Otago, on the 16th, and in Taranaki and Golden Bay on the 20th.

The third rainy period was from the 22nd onward. A cyclone was centred east of Tasmania on the 21st, but thereafter the weather gradually approached the westerly type. Heavy rains occurred in many parts of the South Island from the 22nd to the 24th. Over the North Island precipitation was mainly light and scattered. Northerly gales blew on the 23rd, some damage being done in the Manawatu and Wairarapa districts.

Rainfall for December and Calendar Year, 1931, at Representative Stations.

No.	Station.	December, 1931.				Calendar Year.	
		Total Fall.	Number of Wet Days.	Maximum Fall.	Average December Rainfall.	Rainfall in 1931.	Average Rainfall.
		North Island.					
		Inches.		Inches.	Inches.	Inches.	Inches.
1	Kaitaia	4·27	11	1·68	2·63	33·68	58·07
2	Russell	4·86	8	2·21	2·61	40·59	51·52
3	Whangarei ..	3·88	12	1·18	3·07	49·18	62·27
4	Auckland ..	3·45	10	0·90	2·93	49·34	44·85
5	Hamilton ..	1·65	9	0·88	3·69	42·06	50·88
6	Rotorua ..	1·51	6	0·73	3·89	43·87	55·72
7	Kawhia	2·52	10	1·10	3·43	57·02	54·33
8	New Plymouth ..	4·43	11	1·41	4·38	55·82	60·56
9	Riversdale, Inglewood	7·41	10	1·73	7·69	103·49	105·01
10	Whangamomona ..	3·51	5	1·27	5·96	81·81	78·86
11	Eltham	3·47	8	0·93	4·08	49·64*	56·45
12	Tairua	3·59	9	2·52	4·60	47·54	66·78
13	Tauranga ..	3·20	11	1·93	3·75	40·63	53·51
14	Maraehako, Opotiki	6·16	10	4·46	2·81	51·87	53·61
15	Gisborne ..	0·87	9	0·23	2·37	26·58	45·85
16	Taupo	2·67	10	0·94	3·28	37·00	45·11
17	Napier	2·12	10	0·56	2·35	21·19*	35·90
18	Hastings ..	1·34	11	0·42	2·08	23·38	33·09
19	Taihape	3·01	11	0·87	3·38	37·12	37·77
20	Masterton ..	..	..	..	2·94	..	38·97
21	Patea	4·12	11	0·79	3·66	51·90	45·17
22	Wanganui ..	3·84	10	0·94	2·72	37·87	36·44
23	Foxton	2·43	11	0·65	2·79	32·85	33·28
24	Wellington ..	2·70	10	0·87	2·84	39·49	41·08
		South Island.					
25	Westport ..	8·43	14	2·30	8·45	101·78	96·80
26	Greymouth ..	7·21	16	2·10	8·72	114·40	101·17
27	Hokitika ..	8·34	17	1·70	10·63	105·48	116·35
28	Ross	12·84	16	3·45	12·34	139·55	137·98
29	Arthur's Pass ..	13·81	8	3·83	15·23	184·93	164·07
30	Okuru	11·22	14	3·36	11·42	143·72	147·79
31	Collingwood ..	13·20	9	4·32	7·88	89·52*	97·16
32	Nelson	11·00	9	3·64	2·56	36·35	37·94
33	Spring Creek ..	2·62	8	0·70	2·19	27·09	31·19
35	Hanmer Springs ..	1·77	6	0·61	3·63	42·05	41·83
36	Highfield, Waiau ..	1·45	5	0·75	2·72	29·45	33·93
37	Gore Bay ..	0·36	5	0·22	2·85	28·77	31·64
38	Christchurch ..	0·53	10	0·22	2·19	17·75	25·21
39	Timaru	1·34	12	0·32	2·51	15·61	22·78
40	Lambrook, Fairlie	0·71	8	0·18	2·65	16·42	25·21
41	Benmore, Clearburn	2·19	12	0·57	2·30	22·30	25·15
42	Oamaru ..	1·93	12	0·57	2·26	17·23	22·18
43	Queenstown ..	2·39	9	1·07	2·57	37·13	30·69
44	Clyde	2·63	8	1·32	1·79	17·26	15·32
45	Dunedin.. ..	2·63	15	1·08	3·57	32·86	37·20
46	Wendon ..	4·30	10	1·20	2·72	30·38	30·23
47	Invercargill ..	2·57	16	0·65	4·15	42·15	45·95
48	Puysegur Point ..	8·32	25	1·48	7·01	84·87	86·11
49	Half-moon Bay ..	4·14	15	0·88	5·02	63·21	59·56

* Eleven months only: January missing, Eltham and Collingwood; February missing, Napier.

—*Wellington, 6th January, 1932.*

LIVE-STOCK IN NEW ZEALAND, 1931.

Unless otherwise specified, the enumeration is at 31st January.

Land District.	Horses.	Cattle (including Dairy Cows).	Dairy Cows.		Number of Sheep shorn, 1930–31.	Number of Lambs tailed, 1930–31.	Sheep (including Lambs) as at 30th April, 1931.	Pigs.
			In Milk.	Dry.				
North Auckland	32,177	628,096	264,291	19,906	1,132,923	541,702	1,220,277	76,184
Auckland	45,957	972,617	452,905	25,560	1,697,827	983,405	1,669,573	154,208
Gisborne	17,290	373,472	41,621	4,121	3,024,233	1,242,738	3,079,252	18,104
Hawke's Bay	14,448	243,007	52,230	4,709	2,955,327	1,381,017	2,987,669	14,791
Taranaki	18,976	420,009	220,213	13,530	1,000,074	521,984	965,255	50,043
Wellington	38,383	761,631	213,549	15,756	5,869,959	3,039,524	6,058,943	69,836
Nelson	6,372	70,031	27,332	2,180	396,059	154,831	472,397	13,713
Marlborough	6,613	48,868	15,953	1,124	1,053,852	441,111	1,133,797	6,393
Westland	2,261	45,128	12,652	1,365	76,521	54,401	93,462	5,577
Canterbury	56,111	190,322	73,759	4,928	4,707,688	2,949,510	5,410,909	39,417
Otago	32,148	145,323	53,413	4,058	3,481,235	1,767,406	4,051,920	17,456
Southland	25,007	182,021	71,614	4,864	2,178,591	1,450,680	2,649,062	10,472
Dominion totals ..	295,743	4,080,525	1,499,532	102,101	27,574,289	14,528,309	29,792,516	476,194
Totals, 1930 (or 1929–30)	297,195	3,770,223	1,389,541	51,869	26,999,410	14,887,599	30,841,287	487,793

NOTE.—Statistics for asses and mules and goats were not collected in 1931.

—*Census and Statistics Office.*

CROP AREAS AND YIELDS, SEASONS 1930-31 AND 1929-30.

Crop.	1930–31.		1929–30.	
	Area.	Average Yield per Acre.	Area.	Average Yield per Acre.
Wheat—	Acres.		Acres	
Grain	249,014	30·44 bushels	235,942	30·68 bushels.
Chaff, &c. ..	3,000	2·02 tons	1,491	1·29 tons.
Oats—				
Grain	87,152	38·74 bushels	67,722	44·33 bushels.
Chaff, &c.	223,869	1·64 tons	190,072	1·65 tons.
Barley—				
Grain	23,952	34·97 bushels	18,229	41·42 bushels.
Chaff, &c.	925	1·91 tons	402	2·05 tons.
Maize—				
Grain	7,178	44·20 bushels	7,957	47·50 bushels.
Ensilage	421	4·56 tons	695	3·75 tons.
Peas (for threshing) ..	10,558	22·86 bushels	9,855	29·86 bushels.
Beans (for threshing) ..	140	14·19 bushels	171	21·13 bushels.
Linseed (for threshing)	12,200	7·16 cwt.	7,757	9·07 cwt.
Rye-grass seed—				
Perennial	35,851	367·42 lb.	24,366	407·74 lb.
Western Wolths and Italian	12,091	452·56 lb.	5,719	507·71 lb.
Cocksfoot seed ..	14,001	189·47 lb.	11,729	171·37 lb.
Chewings fescue seed ..	10,593	220·24 lb.	9,808	246·37 lb.
Crested dogstail seed ..	3,312	173·07 lb.	3,404	243·51 lb.
Red clover and cow-grass seed	3,323	192·55 lb.	4,703	221·14 lb.
White clover seed ..	3,339	170·27 lb.	3,710	163·04 lb.
Other grass and clover seeds	6,674*	91·47 lb.	3,446	91·01 lb.
Grass and clover ensilage	114,301	3·33 tons	380,898	2·12 tons.
Grass and clover hay ..	295,285	1·92 tons		
Lucerne hay or ensilage	33,502	..	31,690	..
Potatoes	28,459	5·32 tons	23,214	5·60 tons.
Green fodder crops ..	247,711†	..	203,438	..
Turnips	493,902‡	..	475,254	..
Mangolds	10,706	..	10,519	..
Onions	771	7·52 tons	870	11·80 tons.
Hops	634	§	598	1,409·46 lb.
Tobacco	932	775·03 lb.	1,073	..

* Includes 5,158 acres of brown-top which yielded 74·68 lb. per acre. † Includes wheat, 205 acres; oats, 56,530 acres; barley, 6,157 acres; maize, 4,511 acres; millet, 1,303 acres; rape and/or kale, 167,924 acres; unspecified, 11,081 acres. ‡ Includes 53,688 acres of turnips and rape mixed. § Not available.

—*Census and Statistics Office.*

Dairy Cattle with Foul-in-the-Foot.—The annual report of the Live-stock Division for 1930–31 refers to this trouble as follows: "A considerable number of cases have been seen in all dairying districts and consequently a good deal of monetary loss has resulted therefrom due to the fact that an animal contracting the complaint is practically useless as a dairy unit during that season. Treatment is laborious, and in the majority of cases is not carried out. As this disease is contracted through injuries in the region of the hoof, it should be the aim of every dairy-farmer to prevent such wounds by removing from the yards and roadways all such material as will injure the feet. To prevent infection all yards, &c., should be kept free from dirt, and affected stock should be isolated until all discharge has ceased."

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

CONTROL OF PIRIPIRI.

"SETTLER," Norsewood :—

Could you inform me which is the best way to destroy or prevent the growth of bidibidi [piripiri] where ploughing cannot be done. In two of my paddocks where the grass is short it is increasing, and no animal will eat it.

The Fields Division :—

The development and increase of piripiri in a pasture is due to the weakening and opening-up of the sward and the general grazing management. The fact that the grass is short, and is probably kept continuously short and lacks vigour, is responsible for the successful competition of the piripiri. If there is sufficient grass remaining and it is practicable to top-dress you should do so, spelling the pasture completely for a time. The growth of grass will eventually lift the runners of the piripiri off the ground. Cattle should then be used to clean out the growth. Under such conditions a great amount of the weed will be eaten or pulled up. If after this treatment a certain amount of the piripiri remains, the spelling and grazing should be repeated with cattle from time to time until the weed is fully controlled.

BLOW-FLY TRAPS FOR THE FARM.

"INQUIRER," Tuakau :—

In the December number of the *Journal* a note in the "Farm" section speaks of fly-traps for controlling blow-flies. Would you kindly explain what the traps are and how operated?

The Live-stock Division :—

There are several types of blow-fly traps on the market. One which has been very successfully used in Marlborough during the past year is the "Meteor," made in Australia. This consists of a clear glass gourd-shaped broad and squat bottle 12 in. to 15 in. high and about the same breadth, with a 3 in. or 4 in. opening at the top, and one of from 5 in. to 6 in. in the under part, the bottom being drawn up in a curve to the bottom orifice, leaving a receptacle inside the glass trap about 4 in. deep round its entire circumference for the holding of water, with which it requires to be filled. The bottle sits on four glass knobs or buttons each about ½ in. high, which leaves a space underneath through which the flies enter the trap. The bottle is set upon a petrol-tin or other similar receptacle in the top of which a circular hole about 6 in. in diameter has been made. A generous supply of liver, with about 1 quart of water, is placed in the tin, and the bottle (which requires to be filled with plain water *only*) is placed on top of the tin over the hole. The hole at top of the bottle is then blocked to prevent the escape of the flies by tying a piece of sacking over it or by inserting a suitable plug or cover. This is the only baiting necessary, as once the bottle gets full the dead flies become the bait and are said to be the most alluring of all. Subsequent operations are to leave the bottle even if brimming over until the flies start to blow their own dead inside the bottle, then empty it into a second tin prepared in the same way. Rinse the bottle out into the second tin and place on top filled with fresh water. The first tin can then have its contents, which by then comprise both flies and maggots, destroyed either with boiling water and caustic soda, or by sprinkling with arsenical sheep-dip powder and letting stand for a time. The destruction of the flies and maggots in the tin must be effectively done, and farmers report that to do this quickly is not so easy as it seems. When the bottle is again full it is emptied into the first tin and so on from time to time. Kerosene should not be used near the trap, as it has the effect of driving away the flies. As the water evaporates quickly if left in the sun it is preferable to place the trap in the shade. Some farmers have used a home-made adaptation of this trap with good results, and various other "notions" of the sort may be met with.